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# ASTM BULLETIN

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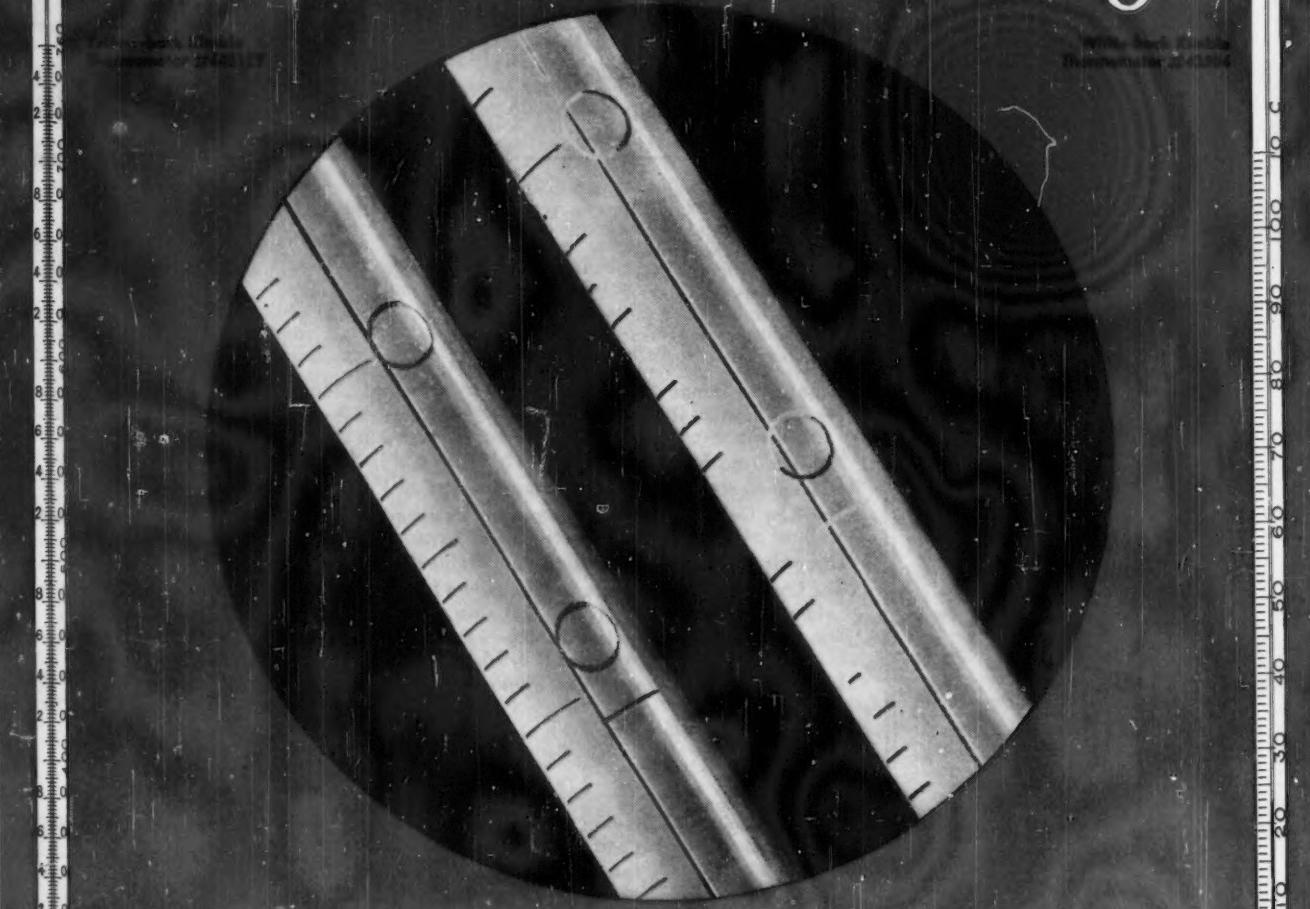
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# *Kimble makes Thermometer history!*



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# ASTM BULLETIN

"Promotion of Knowledge of Materials of Engineering; and Standardization of Specifications and Methods of Testing"

Number 191

July 1953

## Significant Materials Research, New Standards Highlight Annual Meeting

Symposiums Presented on Low-Temperature Effects on Metals, Soils Properties, Radioactivity, Electron Metallography, Porcelain Enamels

Papers and Merit Awards Made; Members Honored; Lectures by Rossini, Strauss; New Officers Inducted

**A**LMOST 2500 members and friends converged in Atlantic City on June 28 to July 3 to attend one of the largest Annual Meetings in ASTM's history. Vieing for the attention of the members were 131 authoritative papers which collectively described much of the current research in structural materials, such as ferrous and non-ferrous metals and alloys, concrete, wood, plastics, and soils. Radioactivity's application in the materials field and industrial topics such as atmospheric sampling and water were also included in the heavy program.

The research results, approval of many new standards, over 550 technical committee meetings, the Marburg Lecture, the Gillett Lecture, numerous awards for merit and for long-time members, an Annual Dinner, a President's Luncheon, and a Publications Exhibit were all included in the week-long, 34-session convention. Seven evening sessions were required for successful scheduling of all the work in the allotted week.

In the paragraphs to follow, details concerning the many features of the meeting are reported.

### Marburg Lecture Presented by Rossini

FREDERICK D. ROSSINI, Silliman Professor of Chemistry and distinguished Head of the Chemistry Department at the Carnegie Institute of Technology, presented the Marburg Lecture on Wednesday before a large gathering of members and friends of ASTM.

Dr. Rossini took the audience for "An Excursion in Petroleum Chemistry." In the words of L. C. Beard, who introduced him: "His technical

productivity can be judged by the fact that he is author or co-author of 150 papers and four books on thermochemistry, chemical-thermodynamics, hydrocarbons and petroleum. . . . This dynamic (or perhaps I should say thermo dynamic) Rossini. . . . By theoretical treatment of the data from his work,<sup>1</sup> has formulated important scientific generalizations concerning petroleum and its composition. . . ."

### Strauss Gives Second Gillett Lecture

"A great metallurgist" was one of the appositives used by H. C. Cross, metallurgist, Battelle Memorial Inst., in introducing this year's Horace

<sup>1</sup> The work referred to above was that of API Project 44 under the Directorship of Dr. Rossini which resulted in the addition of much new and re-evaluated data to the literature of hydrocarbons.

W. Gillett Memorial Lecturer, Jerome Strauss. Long-time friend and intellectual associate of the man he honored on Tuesday, Mr. Strauss took time off from duties as Vice-President and Technical Director, Vanadium Corporation of America, to speak to over 300 members and friends of ASTM. He told them of the sometimes tremendous effects on the properties of metals, of minute additions of alloying elements.

This Lecture, established in 1951, is jointly sponsored by ASTM and Battelle Memorial Inst. It commemorates Dr. Gillett, one of America's leading metallurgists and the first director of Battelle. The first lecture was given at the Fiftieth Anniversary Meeting, June, 1952.

It was gratifying to all concerned



Retiring President Maxwell Greets Incoming President Leslie C. Beard, Jr.

## **Annual Meeting Report**



**Two Distinguished Lecturers**—Frederick D. Rossini and Jerome Strauss. Mr. Rossini gave the Marburg Lecture and Mr. Strauss the Gillett Lecture.

with this lecture to know that Mrs. H. W. Gillett and her son, Edward P. Gillett, were again present for this occasion.

Jerome Strauss's Lecture will be published at a later date in the *Proceedings*, as a separate publication. (For further details on Mr. Strauss, see p. 15.)

### **Medals and Awards**

E. A. Davis and M. J. Manjoine, Research Laboratories, Westinghouse Corp., received the Twenty-fifth Dudley Medal for their paper "Effect of Notch Geometry on Rupture Strength at Elevated Temperatures."

The Eighth Templin Award was made to W. N. Findley, Research Associate Professor, and P. G. Jones, Associate Professor, Department of Theoretical and Applied Mechanics, University of Illinois; W. I. Mitchell, Assistant Professor of Civil Engineering, South Dakota School of Mines; and R. L. Sutherland, Assistant Professor of Mechanical Engineering, University of Iowa for their paper "Fatigue Machines for Low Temperatures and for Miniature Specimens."

J. R. McDowell, Mechanics Division, Research Laboratories, Westinghouse Corp., was given the fourth Sam Tour Award for his paper "Fretting Corrosion Tendencies of Several Combinations of Materials."

Mrs. Katharine Mather's paper "Applications of Light Microscopy in Concrete Research" won the Sanford E. Thompson Award.

All of the awards were made on Wednesday afternoon with ASTM President H. L. Maxwell and Vice-President L. C. Beard presiding. (Biographical

material on the recipients as well as a description of the various Society awards appears on p. 16.

### **Entertainment Features**

#### **Annual Dinner**

On Wednesday there was a pause in the tremendous technical activity generated by the scheduling of six symposiums, 550 committee meetings, and 34 sessions. ASTM'ers gathered in the Carolina Room of the Chalfonte to attend the Annual Dinner, listen to some fine orchestra music and songs, and dance a little (very little because of the weather—around 99.9 F and 99.9 per cent relative humidity!). The Annual Dinner was sponsored and the entertainment underwritten by the Philadelphia District. Active in planning and carrying through were the District Officers E. K. Spring, Chairman, and Tinus Olsen II, Co-chairman. L. Drew Betz was chairman of the Entertainment Committee and E. J. Albert, chairman of the Dinner Committee. In spite of the weather, the affair was most successful. The Philadelphia District hosts worked hard on the plans and they deserve the credit for its success.

### **A WORD OF APPRECIATION**

A FULL measure of credit should be given the Philadelphia District for again serving as host at the Annual Meeting in Atlantic City under the guidance of District Chairman E. K. Spring of Henry Disston and Sons, Inc., who was responsible for augmenting the District funds to underwrite entertainment, and who cooperated very closely with L. Drew Betz of W. H. & L. D. Betz Co. Those at the meeting enjoyed a fine program of entertainment at the dinner, and the ladies had a full and enjoyable week. E. J. Albert of Thwing-Albert Instrument Co. handled the dinner details.

Many comments of appreciation were noted by those at the meeting for the entertainment program. Of the more than 400 ladies registered at the meeting, many stayed for most of the week. There were about 150 present at the Thursday Luncheon, the last event on the Program.

### **Ladies Entertainment**

This year the Philadelphia District Council arranged a fine program for the ASTM ladies who would attend the Annual Meeting, with the wives of the Council Members serving as hostesses. Actually, over 500 registered and, of these, each day's Ladies Program attracted many for participation. On Monday afternoon there was the informal, get-acquainted tea party which was most successful from every point of view. Then on Tuesday there was an exciting ocean boat trip to sight-see the coast of Atlantic City. Mrs. Paul D. Towner ably told the story of the current best-seller, "The Emperors' Lady," for the complete enjoyment of the ladies on Tuesday evening.

On Thursday, Miss Beatrice Moss brought delighted gasps from the assembled lady ASTM'ers when she whipped up stunning hats from a collection of ribbons, felts, flowers, and other feminine bits piled on a table before the audience.

Throughout the week, advantage was taken of the free rolling chair rides provided and in general all week long enjoyment continued at a new high.

### **REGISTRATION—ANNUAL MEETINGS**

	Year	Members	Committee Members	Visitors	Total	Ladies
Buffalo.....	1946	978	405	452	1835	About 100
Atlantic City.....	1947	1071	469	246	1786	320
Detroit.....	1948	1160	358	250	1768	133
Atlantic City.....	1949	1092	530	235	1857	335
Atlantic City.....	1950	1160	637	334	2131	408
Atlantic City.....	1951	1220	660	402	2282	393
New York.....	1952	1375	674	557	2606	280
Atlantic City.....	1953	1290	786	394	2470	445

## President's Address, Introduction of New Officers, Honors for Members, Featured at Luncheon Session

### Retiring President Speaks

ON TUESDAY, June 30, Dr. Harold Maxwell, forty-sixth president of ASTM, prepared to step aside for incoming L. C. Beard, Jr. As part of the traditional, retiring president's address, Dr. Maxwell said "...our every action—every day—is concerned directly with either people or things or both. The relative priority we as free moral agents recognize in dealing with people and things determines in large measure what kind of individuals we are. It is safe to say that we are drawn naturally to an associate who respects people and uses things. We are just as naturally repelled by one who respects things and uses people."

To those who have worked with him, it is clear that Dr. Maxwell and this creed of "respecting people and using things" are one and the same. (For the complete text of the president's talk, "People and Things," see page 43.)

### Directors' Report

Following the president's address, R. J. Painter, Executive Secretary, presented the Annual Report of the Board of Directors. Mr. Painter emphasized "that although the Society's work has been concentrated for over fifty years in the field of materials, it does provide broad coverage of this field...ASTM is not solely a standardizing body...satisfactory standards must be based on the best and latest knowledge. The attention given to research and the publishing of results rounds out the Society's scope and purposes. We can with justification consider that the Society is indeed a Society for materials."

He commended the ASTM Headquarters Staff for its work during the past year and also, in behalf of the Staff, he thanked Dr. Maxwell and the

officers for their efforts in the interests of the Society.

### Incoming Officers

"ASTM belongs to you—the 7500 members," said L. C. Beard, new President, in a brief acknowledgment of his introduction at the Luncheon session. He expressed the aim "...to keep the Society young, energetic, and progressive." C. H. Fellows, Vice-President for the coming year, added that he also would "...continue to promote those things which have made ASTM great."

The new Directors on the Board were introduced. (Complete biographical material concerning the new officers appears on page 10. The Tellers for the election this year were W. J. McCoy, Portland Cement Co., and E. K. Spring, Henry Disston and Sons, Inc.)

Honorary memberships were conferred upon Lloyd B. Jones, Consulting Engineer (posthumously), and H. H. Lester, Physicist, Watertown Arsenal. (See page 13.)

Ten members were honored as recipients of the Award of Merit at the Luncheon for "...intense work and contributions in a specific field..." and because each had "...aided in numerous ways in furthering the general activities of the Society." H. M. Hancock read a brief citation and presented each recipient to President Maxwell who conferred the Award and congratulated the winners. Past-President T. S. Fuller commented: "They have worked hard for the Society, exemplifying that spirit which makes ASTM great." (For a full description and pictures, see page 14.)

Recognition of 50- and 40-year members followed. (See page 8.) Nine 50-year members and thirty-seven 40-year members were honored this year.

## Annual Meeting Report

In retiring from the Board after serving three years as Past-President, J. G. Morrow expressed his appreciation for the honor that had been accorded Canada and himself by ASTM. Mr. Morrow had served a total of eight years as Director, Vice-President, President, and Past-President.

### District Officers Convene at Annual Meeting

ABOUT 40 officers or councilors representing various ASTM districts met during the Annual Meeting in Atlantic City to review district policy and to meet the incoming officers of the Society. C. M. Gambrill, Ethyl Corp., Chairman of the Administrative Committee on District Activities, presided and introduced Messrs. Maxwell, Beard, Mochel, and Fellows. Brief comments were made also by Executive Secretary, R. J. Painter, who noted that the Executive Committee of the Board of Directors feels it would be quite desirable to stimulate talks on the applications of materials. Actually, many of the technical papers and talks given at district meetings do cover this field, but it is the plan to keep applications and uses in mind especially.

This annual breakfast meeting is sponsored by the Administrative Committee on District Activities. At the ACDA meeting, held the day prior to the annual breakfast, a number of policy matters were reviewed and pertinent recommendations were discussed with the councilors. The group feels that the district councils are doing very commendable work in carrying out their purpose of stimulating an interest in the Society's work in their respective areas.

### SUMMARY OF ACTIONS TAKEN AT ANNUAL MEETING AFFECTING STANDARDS AND TENTATIVES.

	Existing Tentatives Adopted as Standard	Standards in Which Revisions Will be Adopted	New Tentatives	Revisions of Standard and Revision to Tentative	Tentative Revisions of Standards	Existing Tentatives Revised	Standards and Tentatives Withdrawn
A. Ferrous Metals—Steel, Cast Iron, Wrought Iron, Alloys, etc.....	5	10	5	1	1	22	1
B. Non-Ferrous Metals—Copper, Zinc, Lead, Aluminum, Alloys, etc.	120	6	4	10	27	0	0
C. Cement, Lime, Gypsum, Concrete and Clay Products.....	10	11	10	1	7	0	0
D. Paints, Petroleum Products, Bituminous Materials, Paper, Textiles, Plastics, Rubber, Soap, Water, etc.....	37	24	40	3	10	43	8
E. Miscellaneous Subjects, Testing, etc.....	2	3	3	0	12	0	0
Total.....	62	54	62	5	28	99	21

## Annual Meeting Report

### Technical Sessions

#### Symposium on Metallic Materials at Low Temperatures

THE outstanding technical feature of the Fifty-sixth Annual Meeting was probably the Symposium on Metallic Materials at Low Temperatures sponsored by the ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals. The first session of this five-session Symposium was held Sunday evening, June 28. Wide interest in this subject was evidenced by the fact that more than 200 people attended.

A. L. Tarr, Corps of Engineers, Chairman of the committee which developed this symposium explained that the symposium has been presented in the hope that it will help to improve industrial practices in the selection of materials and designs for low-temperature service and will furnish a guide for the Low-Temperature Panel of the ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals in its mission of collecting information on present industrial practices and testing procedures and making it available to engineers.

The first session, devoted to evaluation of brittle failures in ships and engineering structures, included three papers (by K. K. Cowart, M. L. Williams, and M. E. Shank) which discussed correlation between service experience and laboratory testing, effects of residual stress, steel composition and treatment, strain rate, and other factors.

The second session was concerned with criteria of metal behavior for design engineers. The Army's interest (T. T. Paul) in brittle failures is one of long standing and of serious consideration, and it is related not only to gun fractures and resultant accidents to gun crews, but to the secondary resultant serious effect on the morale of the entire organization. E. R. Parker of the University of California summarized the effects of various factors known to contribute to the brittle behavior of steel including notch effect, welding, and chemical factors. The paper, "Brittle Fracture: Significance for Engineers," S. L. Hoyt, discussed transition temperature, pointing out that it is only indirectly related to service fractures. The principle of matching service failure with the test bar geometry which produces brittle fracture at the surface temperature was also discussed.

The third session of this Symposium dealt with mechanical and metallurgical factors. The paper by C. H. Lorig

indicates that for the most part steels become stronger and harder with decreasing temperature and that while certain austenitic steels remain ductile and tough, other austenitic and all ferritic steels become brittle-sensitive at low temperatures. The behavior of the brittle-sensitive steels is closely related to composition, alloy content, microstructure, and heat treatment.

In "Fundamentals of Fracture in Metals," M. Gensamer included discussions of ductile and brittle fractures, cleavage and shear fractures, and fibrous and crystalline fractures. The effect of size as discussed by G. R. Irwin indicates that the primary causes of fracture are (1) the tendency for fracture propagation work to approach portionality to severed area and (2) the distribution of local flaws for ductile and brittle fracture. W. P. Roop advances the concept of localization of strain as being more useful than that of triaxiality of stress. This concept may lead to an analysis of cold brittleness in terms of relations between the strain field and advance of the incipient crack. In a paper on "Effect of Metallurgical Structure on the Impact Properties of Steels," J. A. Rinebolt, the effects of carbon, phosphorus, silicon, manganese,

and nickel on transition temperatures for three types of microstructures were reported and the paper shows that the first three elements raised the transition temperature while magnesium and nickel lowered it. The effects on the three microstructures were in general quite similar.

The fourth session of the low-temperature session included papers dealing with the significance and reliability of notch toughness tests. The titles of the papers are indicative of the nature of this session: "Evaluation of the Significance of Charpy Tests" (Pellini), "Significance of V-Notched Impact Test in Evaluation of Armor Plate" (Hurlich), "Notch Bend Tests for Evaluating the Properties of Weldments" (Stout), "Reproducibility of Keyhole Charpy and Tear-Test Data on Laboratory Heats of Semikilled Steels" (Frazier, et al.), and "Effect of Specimen Preparation on Notch Toughness Behavior of Keyhole Charpy Specimens in the Transition Temperature Zone" (Vanderbeck, et al.). The last item in this session was a high-speed motion picture study of the impact test, by H. L. Fry.

The concluding session related to certain aspects of current research including new data on titanium (Driscoll) quenched and tempered steels at high strength levels (five papers: Schwartz-

*A feature of the President's Luncheon was recognition of the following individuals and organizations who have held membership in the Society for 50 and 40 years.*

#### 50 YEAR MEMBERS

Frederick W. Bateman  
The Carpenter Steel Co.  
Central Iron and Steel Co.\*  
Almon M. Fuller  
Arthur D. Little, Inc.

Herbert F. Moore  
National Lead Co.  
Pennsylvania State Highway Dept.  
C. P. Van Gundy  
L. W. Walter

#### 40 YEAR MEMBERS

American Car and Foundry Co.  
Louis Anderson  
The Atlantic Refining Co.  
John M. Bierer  
A. Burton Cohen  
Combustion Engineering, Inc.  
Compressed Gas Manufacturers Assn., Inc.  
Cork University College Library  
John J. Crowe  
Henry Disston and Sons, Inc.  
Electro Metallurgical Div., Union Carbide  
and Carbon Corp.  
Dudley K. French  
Giant Portland Cement Co.  
Dean Harvey  
Hydro-Electric Power Commission of Ontario  
Burgis D. Jennings  
Arthur M. Johnsen  
Leeds & Northrup Co.

Missouri State Mining Experiment  
Station, Ceramics Division  
Northern Pacific Railway Co.  
The Ohio Brass Co.  
Oliver Iron and Steel Corp.  
Otis Elevator Co.  
The Pennsylvania Railroad Co.  
Julian A. Pollak  
University of Queensland  
Ralph E. Roscoe  
Rutgers University, School of Ceramics  
Seattle, City Engineer's Dept.  
Henry T. Shelley  
The A. P. Smith Manufacturing Co.  
Tennessee Coal and Iron Division,  
U. S. Steel Corp.  
Toronto, Department of Public Works  
Valentine and Co., Inc.  
C. Benson Wigton  
L. H. Winkler  
Harry Wolf

\* This membership dates from 1902.

## Annual Meeting Report

bart, Baeyertz, Tour, Ripling, Mayne), high-purity iron (Hall) and several types of cast irons (four papers Vanick, Gilbert (2), Kraft). This session provided a broad coverage which should go a long way toward eliminating many misconceptions regarding the function and suitability of laboratory and simulated service tests and also to give design engineers a new approach to design data.

One of the features of the Low-Temperature Symposium was the educational exhibit displayed in the hall adjacent to the session room. This display included contributions from the New York Naval Shipyard and the U. S. Naval Research Laboratory. The display from the Research Laboratory was centered about a number of ruptured 1-in. steel plates. The New York Naval Shipyard display included a number of specimens showing the effect of transition temperature and steel treatment on brittle fracture. An additional feature was an illuminated question and answer board for self-quizzing. An accompanying photograph shows a portion of this exhibit.

Present plans call for the publication of this symposium material in somewhat condensed form in one volume which will be available near the end of this year. The Papers Committee of the Society has allotted approximately 600 pages to this publication.

### Sessions on Steel

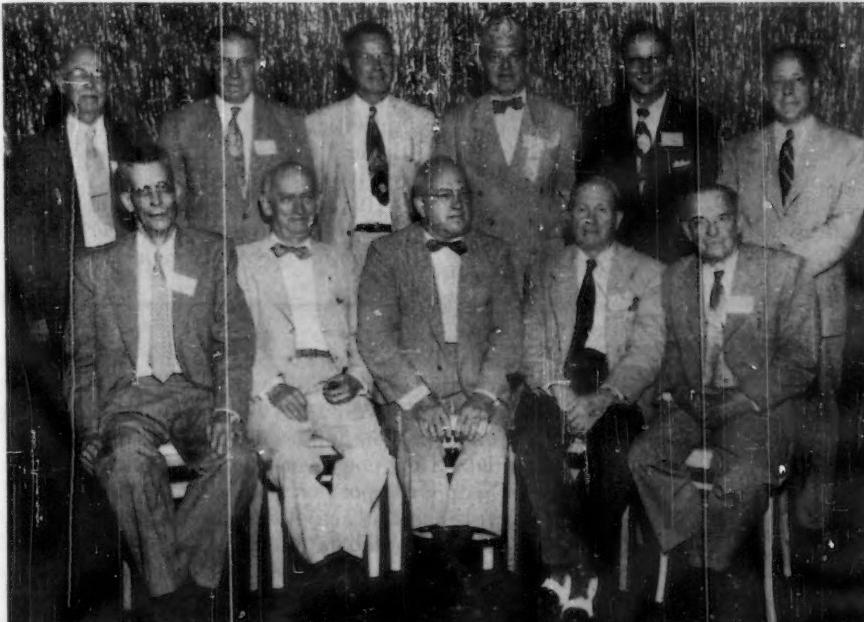
A NEWER, high-strength rivet steel was studied by methodic Frank Baron and Edward W. Larson, Jr. Their resulting paper (presented in the first of two sessions devoted more or less to unrelated topics under the broad heading of steel) offered some conclusions on the properties and behavior of the new alloy. They found that contrary to claims sometimes made about poor ductility and post-driving impact strength in high-strength rivet steel, the new alloy met strength requirements of ASTM specification A 195 and was "driven as easily and quickly as ordinary . . ." carbon steel rivets. Also at grip lengths of 2 in. and greater, they found the average clamping stresses of the high-strength steel rivets appreciably greater than those of carbon steel rivets. They also concluded that the fatigue strength of butt joints fastened with alloy steel rivets was greater than that of similar joints fastened with carbon steel rivets, when the grips were  $1\frac{3}{16}$  and  $4\frac{1}{16}$  in.

C. E. Work and T. J. Dolan investigated the "Influence of Strain Rate and Temperature on the Strength and Ductility of Mild Steel in Torsion." For the

(Continued on page 12)



Individuals and representatives of companies who have been members of ASTM for 50 years. Seated, left to right; L. W. Walker; W. F. Collins, representing Herbert F. Moore. Standing, B. T. Lanphier, The Carpenter Steel Co.; W. H. Herman, Pennsylvania State Highway Dept.; C. H. Rose, National Lead Co.



Individuals and representatives of companies who have been members of ASTM for 40 years. Seated, left to right: R. W. Parsons, Ohio Brass Co.; L. H. Winkler, Bethlehem Steel Co.; C. T. Raber, Giant Portland Cement Co.; R. E. Roscoe; D. K. French. Standing: Dean Havey; H. M. Hancock, The Atlantic Refining Co.; W. N. Boyd, Oliver Iron and Steel Corp.; J. R. Trimble, Tennessee Coal and Iron Div., U. S. Steel Corp.; V. W. J. Franceschini, Otis Elevator Co.; R. C. Machler, Leeds & Northrup Co.

## **Annual Meeting Report**

### **PRESIDENT**



### **VICE PRESIDENT**



### **DIRECTOR**



## **New Officers**

**Leslie C. Beard, Jr.**, Assistant Director of Socony-Vacuum Laboratories, Socony-Vacuum Oil Co., Inc., was born in Hagerstown, Md. He received his B.A. from Johns Hopkins University in 1919 and his doctorate in 1922. Following a period on the faculty of the Baltimore College of Dental Surgery and as Instructor of Chemistry at Johns Hopkins, Dr. Beard became Research Chemist of the Standard Oil Co. of New York. He was later Supervisor of Research, and since 1933 has been Assistant Director of the Socony-Vacuum Laboratories.

The new President is the author of numerous papers on petroleum technology and the patentee of a number of processes. He was one of the early contributors to the technique of improving petroleum products through the use of additives.

Associated with ASTM for many years, Dr. Beard has been particularly active in Committee D-2 on Petroleum Products and Lubricants. In Committee D-2, he serves actively on Technical Committee A on gasoline. He is also a member of Research Division VII, Sections A on Viscosity Methods and C on Viscosity-Temperature Relationships. In addition he serves on the Coordinating Divisions of Research and Public Relations. He has been Chairman of several of the subgroups; currently he is First Vice-Chairman of the main committee and serves on the Advisory group. He is also active in research work on flow properties. He serves on the New York District Council and was a member of the ASTM Administrative Committee on Research. From 1948 to 1951 Dr. Beard was a Director of the Society, and Vice-President from 1951 to 1953.

His other memberships include American Chemical Society, American Petroleum Institute, American Association for the Advancement of Science, and Phi Beta Kappa.

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**Claire H. Fellows**, Director, Engineering Laboratory and Research Department, The Detroit Edison Co., is a native of Kalamazoo, Mich. He earned his B.S. in chemical engineering at Purdue University and has been associated with the Detroit Edison Co. since 1919, heading the Chemical Division of the Research Department from 1925 until 1951 when he was appointed Acting Head of the Department. In 1952, Mr. Fellows became director of the Engineering Laboratory and Research Department. He has been concerned with water treatment and corrosion problems in steam generating plants and has prepared many papers and reports in these fields.

Mr. Fellows, who has been a member of ASTM for many years, was a director for two separate terms, and serves actively in the work of technical committees D-9 on Electrical Insulating Materials; D-19 on Industrial Water; D-2 on Petroleum Products and Lubricants; and A-5 on Corrosion of Iron and Steel. He served for several years on the Detroit District Council of which he is past-chairman, and has been chairman of the Administrative Committee on District Activities. He was formerly chairman of the Joint Research Committee on Boiler Feedwater Studies and is currently the ASTM representative on its Executive Committee.

His other memberships, include American Chemical Society, National Association of Corrosion Engineers, American Water Works Assn., American Association for the Advancement of Science, and Engineering Society of Detroit.

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**Neil A. Fowler**, Director of Sales and Research, General Box Co., was born in Ridgeville, Ind. and attended Purdue University.

During World War II he was chief of the Packaging Branch, Army Ordnance Corps, and in this position his responsibilities included the preservation, identification, and packing of all Ordnance material. He is now a consultant on Packaging to the Army Ordnance Corp.

In his present position with General Box Co. as Director of Sales and Research, Mr. Fowler supervises the sales activities of ten factories. In addition, he supervises advertising activities and the work of two laboratories engaged in basic research and development work with shipping containers, as well as design and testing for industrial products.

Mr. Fowler has been a member of ASTM for many years, an active participant in many phases of the work of Committee D-10 on Shipping Containers. He is a member of the ASTM Advisory Committee to the Army Ordnance Corps and was formerly ASTM representative and Chairman of the Munitions Board Packaging Industry Advisory Committee, of which he is now a member.

His other memberships include the National Research Council Advisory Committee to Quartermaster Corps on Preservation, Packaging and Packing, National Security Industrial Association Advisory Committee on Packaging, Forest Products Packaging Council (Past-President).

## Annual Meeting Report

**Richard T. Kropf** Vice-President, Industrial Thread Division, Belding Heminway, Corticelli, is a native of Chicago, Ill. Following his graduation from Massachusetts Institute of Technology in 1931 he became associated with Belding Heminway, Corticelli, as a research engineer. Following a four-year period as laboratory director, he moved to New York as merchandise manager and technical director, and was named Director of Research in 1943. He has been in his present position as Vice-President and Director of Research since 1949. His fields have been natural and synthetic fiber yarn and thread, mechanical applications of textiles, and development of sewing threads and yarns for specific mechanical and chemical applications.

Mr. Kropf has been a member of ASTM for a number of years, working on Committee D-13 on Textile Materials. He is currently Second Vice-Chairman of D-13, Chairman of Subcommittee C-2 on Papers, a member of the Advisory Subcommittee, and other working groups.

In addition to ASTM, he holds memberships in the American Chemical Society, American Physical Society, Textile Research Institute, American Association of Textile Technologists, and the Technical Industrial Intelligence Committee. He is Treasurer of The Fiber Society, Past-President of the New York Academy of Science, and Scientific Consultant to the Quartermaster General.

DIRECTOR



**Theodore F. Olt** Director, Research Laboratories, Armco Steel Corp., was born in Dayton, Ohio, and received his B.S. degree in chemical engineering from the University of Cincinnati.

He was employed in the Laboratory of Lowe Bros. Co., Dayton, Ohio, and later took a position as a chemist with Fischer Soap and Oil Co. in Cincinnati. He has been associated with Armco Steel in Middletown, Ohio, since 1928; as a metallurgist 1928-1934; senior research engineer in Research Division 1934-1937; supervising metallurgist 1937-1940; associate director of research 1940-1945; assistant director of research 1945-1947 and since 1947 has held his present position as Director of Research.

Mr. Olt has been a member of ASTM for many years. He represents his company on Committee A-1 on Steel; A-5 on Corrosion of Iron and Steel, where he serves on Subcommittee XI on Sheet Specifications; and A-10 on Iron-Chromium, Iron-Chromium-Nickel, and Related Alloys.

His memberships in other societies include American Iron and Steel Institute (Chairman of Stainless Steel Technical Committee) British Iron and Steel Institute, American Society for Metals, Society of Automotive Engineers, Electro Chemical Society, British Institute of Metals, American Institute of Mining and Metallurgical Engineers, and others.

DIRECTOR



**John R. Townsend** Director of Material and Standards Engineering, Sandia Corp., is a native of Baltimore, Md. He attended Baltimore City College and Brooklyn Polytechnic Institute.

Mr. Townsend has been associated with the Bell System for more than 30 years, he has held the positions of materials standards engineer, materials engineer, and Director of Materials Application Engineering, to which position he was appointed early in 1952. Last December he was named Director of Material and Standards Engineering of the Sandia Corp.

Mr. Townsend has a long record of intensive service in ASTM. He was President of the Society 1945-1946, having previously been a Director from 1938 to 1940. He is at present Chairman of Committee E-1 on Methods of Testing. A most important contribution was his work as Chairman of Committee B-6 on Die-Cast Metals and Alloys for 18 years. In 1930 Mr. Townsend received the Charles B. Dudley Medal.

In addition to ASTM he holds membership in the American Standards Assn. where he is currently Chairman of the Standards Council. He organized and is a member of the Committee on Materials of the Research and Development Board; and is a member of the Minerals and Metals Advisory Board of the National Academy of Science. In 1952 he organized the American-British-Canadian Committee on Engineering Standards.

DIRECTOR



**Kenneth B. Woods** Associate Director, Joint Highway Research Project, and Professor of Highway Engineering, Purdue University, Engineering Experiment Station, was born in Sunnyside, Wash. He received his degree in civil engineering from Ohio State University and his professional degree in civil engineering in 1937.

Professor Woods' association with Purdue University began in 1939 and he was appointed to his present position as Professor of Highway Engineering in 1946. In 1939 he was also Assistant Director, Joint Highway Research Project, and was named Associate Director in 1945. The Highway Research Board honored him with its Distinguished Service Award in 1949.

Professor Woods is a member of Committees D-4 on Road and Paving Materials and D-18 on Soils for Engineering Purposes; he is Chairman of Committee C-9 on Concrete and Concrete Aggregates; and has served on the administrative Committee on Papers and Publications.

Memberships in other societies include American Society of Civil Engineers, The Association of Asphalt Paving Technologists, American Road Builders' Assn., American Concrete Institute, The Society of American Military Engineers, The American Society for Engineering Education, U. S. Council on Soil Mechanics and Foundation Engineering, and American Railway Engineering Assn.

DIRECTOR



## Annual Meeting Report

(Continued from page 9)

conditions of their experiments they found in general that increase in strain rate caused increase in strength, whereas increase in temperature reduced strength except in the blue-brittle temperature range. Extremely great ductility was observed at the highest temperature (1000 F), particularly at the slower rates of straining (0.0001 in. per in. per sec, etc.). Some mathematical equations linking temperature and strain rate with some of the mechanical properties of the steel were developed.

In the paper "Creep and Creep-Rupture to Some Ferritic Steels Containing 5 per cent to 17 per cent Chromium," by E. J. Dulis and G. V. Smith, data on creep and creep-rupture properties were presented for eleven steels, ranging in alloy content from 5 Cr- $\frac{1}{2}$  Mo to 17 Cr, with additions of silicon, titanium, columbium, or boron to some. Including some observations on the mechanism of flow and fracture, observations are described on microstructural changes observed after tests, including carbide spheroidization and crystallization.

Also in this session, a group of three papers were presented by authors from the Lewis Flight Propulsion Laboratory, the National Advisory Committee for Aerodynamics. They dealt with the influence of sharp notches on stress-rupture characteristics of heat-resistant alloys, the effect of time and temperature on the notch effect and the influence of notch depth in stress-rupture tests on a chromium-vanadium-molybdenum steel. Two of the authors also investigated the time-temperature relations for correlation and extrapolation of stress-rupture data. The three papers were co-authored by various combinations

of the four authors; W. F. Brown, Jr., M. H. Jones, D. P. Newman, and S. S. Manson. These three papers were presented by author Brown. The second session on steel was devoted to papers on several pertinent topics.

The first paper, "Tension Impact Testing of Sheet Metal," discussed test specimens and fittings developed to determine the impact strength of sheet metals up to 0.125 in. thick. The author, Carl W. Muhlenbruch, Northwestern University, concluded that the test results warranted a number of general conclusions. Satisfactory transmission of energy load to test specimens and good reproducibility are obtainable; the test procedure is easily followed; determination of quantitative values of fracture toughness is possible.

The purpose of Mrs. Helen D. Hoover's paper was to measure the directional differences that are known to exist between straight-rolled, and cross-rolled steel. Of several methods tried, only the Navy tear test was found to yield this information. R. L. Rickett, W. B. Seens, R. Roeloffs, R. W. Vanderbeck, and C. Daniel investigated the results of impact tests conducted under closely comparable conditions on 20 machines made by four manufacturers. Their conclusions included the statement that "there are statistically significant differences among the machines in precision for reproducibility of results."

The paper by J. E. Johnson, D. S. Wood, and D. S. Clark, "Delayed Yielding in Annealed Low-Carbon Steel Under Compression Impact," concludes that delay times exist and are of the same nature as those found in rapid-load tension tests and that compression

impact tests are useful for determining delay times of smaller magnitude than can be determined from rapid-load tension tests.

### Sessions on Fatigue

AT A session on June 30 and another on July 1 sponsored by Committee E-9 on Fatigue, extremely interesting discussions resulted after presentation of nine papers on fatigue testing of metals. These discussions will be printed with the papers, since they add much to the technical value of the data presented. The papers included the following:

The Effect of Range of Stress on Fatigue Strength of SAE 4340 Steel in Bending and Torsion With and Without a Notch—W. N. Findley, University of Illinois.

Influence of Grain Size on Fatigue Notch-Sensitivity—R. W. Karry and T. J. Dolan, University of Illinois.

Static and Fatigue Properties of Carbon, Silicon, and High-Strength Low-Alloy Reamed Steel Plates—Frank Baron and Edward W. Larson, Jr., Northwestern University.

Strength Properties of Rolled Aluminum Alloys Under Various Combinations of Alternating and Mean Axial Fatigue Stresses—B. J. Lazan and A. A. Blatherwick, University of Minnesota.

An Investigation of the Effects of Overstress on the Fatigue Characteristics of Certain Wrought Sheet Magnesium Alloys—Joseph Viglione and Forrest S. Williams, Naval Air Material Center.

Investigation of Prot Accelerated Fatigue Test—E. J. Ward, D. C. Schwartz, and R. T. Schwartz, Wright Air Development Center.

Elevated Temperature Fatigue Properties of SAE 4340 Steel—W. J. Trapp and R. T. Schwartz, Wright Air Development Center.

Damping, Elasticity, and Fatigue Properties of Unnotched and Notched N-155 at Room and Elevated Temperatures—L. J. Demer and B. J. Lazan, University of Minnesota.

Testing Machine for Random Fatigue Testing—A. M. Freudenthal, Columbia University.

Practically all the authors employed statistical analysis in their investigations which illustrates quite properly the importance of this branch of mathematics in fatigue testing.

### Session on Corrosion

THE subject of the Preece test has for years been a question of debate in the field of corrosion. A paper prepared by three authors from the National Bureau of Standards and appended to the 1953 Report of A-5 on Corrosion of Iron and Steel concluded that the number of dips which a galvanized coating will withstand in a Preece test is dependent not only upon its thickness but also upon its uniformity composition, and type, and concludes, therefore, that the Preece test cannot be

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The Traveling Print Show of the Photographic Society of America was a feature of the Annual Meeting.

## Honorary Memberships Conferred

**Lloyd B. Jones**



The Society's most signal honor—election to honorary membership—was bestowed at the Annual Meeting upon Horace Hardy Lester and posthumously upon Lloyd B. Jones who died June 7, 1953.

Mr. Jones knew of his election prior to his death, and his son, Charles Jones, attended the President's Luncheon to receive from President Maxwell both the Certificate of Honorary Membership and the expression of the Society's sincere sympathy to him and to his mother.

**L. B. Jones—Railway Engineer of Tests**

Lloyd B. Jones, retired Engineer of Tests, Pennsylvania Railroad Co. (Altoona, Pa.), and Consulting Engineer (Malvern, Pa.), was born in West Grove, Pa., in 1882.

Graduating in 1904 from Cornell University (with M.E. degree), Mr. Jones began his extended service with the Pennsylvania Railroad Co. in that year as a Special Apprentice. Prior to graduation he had been in the service of the Westinghouse Electric and Manufacturing Co. and the Electric Storage Battery Co. for brief periods.

In his 44 years with the Pennsylvania Railroad he was successively Apprentice, Assistant Engineer of Motive Power, Master Mechanic, and Engineer of Tests. In addition to the normal duties of these positions he devoted considerable time to the early development of locomotive stokers, coal-handling and car-dumping machinery, and shop design and facilities; and has been granted at least 15 United States Patents dealing with railroad machinery and equipment.

A member of the Society since 1937, Mr. Jones made important contributions in both administrative and technical phases of the work.

He was a member of the Board of Directors, 1944-1947; served on the Administrative Committee on Standards from 1943, directing this group as Chairman from 1950; and was a member of the Administrative Committee on Simulated Service Testing since 1947. At the time of his death he was a member of the Philadelphia District Council.

In ASTM technical work his most important contributions were in Committee A-1 on Steel, where through the years he participated in the deliberations of the Advisory group and numer-

**Horace H. Lester**



ous subcommittees. An authority on locomotive and railroad-car design, and an expert on many materials used in the railroads field, Mr. Jones unstintingly gave the benefit of his knowledge and sound judgment in the operation of Committee A-1. Enjoying the respect of his fellow-consumers, and the many producers of materials which he evaluated for his railroad, he was in a splendid position to give constructive advice. In recognition of his outstanding and valued aid Committee A-1 elected him to honorary membership in their group in 1950.

He also served constructively in the following groups: Committee A-2 on Wrought Iron, Committee C-1 on Cement, Joint (AWS-ASTM) Committee on Filler Metal, Committee E-1 on Methods of Testing; and as representative of ASTM on ASA Mechanical Standards Board.

**H. H. Lester—Arsenal Physicist**

Horace H. Lester, Principal Physicist since 1922 at Watertown Arsenal, Department of the Army, Watertown, Mass., was born in 1884 in Shelburn, Ind. He received his B.A. in 1906 from the University of Minnesota, his M.A. from the University of Washington (Seattle) in 1912, and Ph.D. from Princeton in 1915. He was Instructor in Physics at Princeton, 1914-1915, and at Washington (Seattle), 1915-1917; Radio Laboratorian, Puget Sound Navy Yard, 1907-1920; Physicist, Westinghouse Lamp Co., 1920-1921; and Assistant Professor at Case Institute of Technology, 1921-1922.

Eminent in the radiographic field, his

research activities embracing many phases of radiographic work, he has contributed especially to developments in index of refraction of water, thermionics, radiography of metals, defects in cast steel, elastic properties of iron crystals in steel, distribution of carbon in steel, and X-ray metallography.

Dr. Lester has been affiliated with ASTM since 1924 and has rendered outstanding service to the Society. His pioneering efforts in the field of industrial radiography; his leadership in the formation of ASTM Committee E-7 on Non-Destructive Testing and as Chairman of that group from 1938 to 1948, and his continuing contributions in this committee; his stimulation of research work in various fields of non-destructive testing; his encouragement of other workers, and his interest in the committee sponsorship of technical papers and symposiums—have resulted in valued assistance by the Society to industry and government.

While his efforts in the Society have been concentrated chiefly in Committee E-7, Dr. Lester has made important contributions in other committees, including A-1 on Steel, E-4 on Metallography, and the Joint Committee (American Crystallographic Assn., British Institute of Physics, and ASTM) on Chemical Analysis by Powder Diffraction Methods. For some years he has represented the Society on ASA Sectional Committee Z 54 on Safety Code for the Industrial Use of X-Rays.

A member of the New England District Council of the Society since its organization in 1946, Dr. Lester has served as Council Chairman since 1950.

## Annual Meeting Report



Everett G. Ham



James T. MacKenzie



Dalton G. Miller



Rudolph E. Peterson



Carlton H. Rose

### "For Distinguished Service"—Awards of Merit

TEN men who have rendered distinguished service to the Society were honored with Awards of Merit at the President's Luncheon, Tuesday, June 30.

The recipients, all of whom were present, were given their Awards in the form of special certificates, by President Maxwell following brief citations by H. M. Hancock, Chairman of the Award of Merit Committee.

Under the rules of the Award of Merit, which was established by the Board of Directors in 1949, each technical committee may suggest one candidate annually. These suggestions, together with any from other areas of the Society's activities, are reviewed by the Award Committee and nominations made to the Board of Directors. Long-time service to ASTM, marked leadership, and outstanding research and authorship, particularly in the fields of technical activity, are the chief criteria of selection.

The following citations indicate the spheres of activity and particular services rendered by each of those receiving this honor.

To **Everett G. Ham**, Technical Director, John A. Manning Paper Co., Troy, N. Y., for long-time, productive service in ASTM committee work, notably in Committee D-6 on Paper and Paper Products, and also in the work of Committee D-9 on Electrical Insulating Materials; and for leadership in administrative activities, as well as in the technical field.

Formerly a Director of the Society and chairman of its Membership Committee, Mr. Ham rendered particularly constructive service in coordinating various committee activities and in contact work with other societies including the Technical Association of the Pulp and Paper Industry. His service in ASTM dates from 1927, and he was a founding member of Committee D-6 when it was organized in 1937.

To **James Tucker MacKenzie**, Technical Director, American Cast Iron Pipe Co., Birmingham, Ala., leading authority in the field of cast iron and other materials, for long-time leadership in Committee A-3 on Cast Iron, for constructive service in other ASTM technical fields, and for liaison

work in other societies which has advanced the purposes of ASTM.

A member of the Society for 35 years, and twice a Director, Dr. MacKenzie has served on Committee A-3 since 1926—was chairman for two terms, and contributed a great deal to the work of numerous subcommittees. Other fields of Society work in which he has been active include steel, corrosion, coal and iron, methods of testing, and chemical analysis of metals. He has received many honors from other societies, especially the American Foundrymen's Society. In 1951 he received the Herty Medal of the American Chemical Society, Georgia Section, for his "research in metals."

To **Dalton Giles Miller**, retired Materials Engineer, Bureau of Public Roads, U. S. Department of Commerce, University of Minnesota, St. Paul, Minn., for notable service to the Society, particularly in Committee C-1 on Cement where he has contributed important papers and reports, and for service in other fields of ASTM work.

Active in the work of Committee C-1 for over 15 years, and also serving on

Committees C-4 on Clay Pipe and C-15 on Manufactured Masonry Units, he is a recognized authority on the durability of concrete and related materials. Included in his list of papers is a new annotated bibliography on "Sulfate Resistance of Portland Cements, Concrete and Mortars" which will be published in the near future under the sponsorship of the Subcommittee on Sulfate Resistance of C-1.

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To **Rudolph Earl Peterson**, Manager, Mechanics Division, Westinghouse Research Laboratories, Westinghouse Electric Corp., East Pittsburgh, Pa., for meritorious service to the Society, particularly in the organization and work of Committee E-9 on Fatigue. A member of the Research Committee on Fatigue of Metals for 15 years, he then became first chairman of Committee E-9, and has continued since 1946 in that capacity.

A notable work project carried on under his leadership was the compilation of the Manual on Fatigue Testing. He has served ASTM in several administrative capacities involving work on simulated service testing. A Past-President of the Society for Experimental Stress Analysis, he also has been particularly active in the work of The American Society of Mechanical Engineers, especially its Applied Mechanics Division. He has prepared many technical papers in the materials field and in various ways has advanced knowledge of the properties and testing of materials.

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To **Carlton Higbee Rose**, Manager of the Washington (D. C.) Office of the National Lead Co., recognizing distinguished service to the Society, especially in Committee D-1 on Paint, Varnish, Lacquer, and Related Products, of which he was assistant secretary for two years, later secretary for four terms, and where he has con-

tributed to work of many subcommittees.

A former Director of the Society, and chairman of its Membership Committee, he has served ASTM in other capacities, including representation on the Standards Council of the American Standards Assn, and in significant liaison work with the Federation of Paint and Varnish Production Clubs, of which he is a Past-President. As Associate Editor of *Chemical Abstracts* (ACS), he has a notable record of service, especially in the preparation of the section concerned with paints and related materials.

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To **Walter Alfred Selvig**, Senior Chemist, U. S. Bureau of Mines, Pittsburgh, Pa., for outstanding contributions to knowledge of the chemistry of American coals and the development of testing methods, and particularly for notable service for 28 years as secretary of Committee D-5 on Coal and Coke, and later for four years as chairman.

His many publications, especially those concerned with methods of testing, have been invaluable to the producer and consumer of coal. These include more than 60 Bureau of Mines publications which cover among other studies the composition and corrosive action of waters from mines. His work in the international field, particularly involving coal classification, has been notable and important.

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To **Erle I. Shobert II**, Manager, Research and Engineering, Carbon Division, Stackpole Carbon Co., St. Marys, Pa., for efficient and productive services in Committee B-4 on Electrical-Heating, Resistance, and Related Alloys, and particularly for notable work on electrical contacts, and the preparation of the outstanding Bibliography and Abstracts on Electrical Contacts.

A completely revised edition of the

Bibliography has just been issued. The 1944 publication and its subsequent supplements, and the recent new book represent a tremendous amount of time and effort expended largely by Mr. Shobert, with assistance from section members. He has been active in several B-4 subgroups, and has been vice-chairman of the main committee for several years. Active also in other technical societies, he has written numerous technical papers and has been granted a number of patents in the electrical contact and other fields.

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To **Earl Raimon Stivers**, Director, Package Research Laboratory, Rockaway, N. J., for distinguished service to the Society, especially in the field of packaging, as represented particularly by leadership, enthusiasm, and technical knowledge reflected in the work of Committee D-10 on Shipping Containers where he was secretary 16 years, and later vice-chairman and acting chairman.

His enthusiasm and initiative have had a most important part in the progress of Committee D-10. An outstanding authority on tests and specifications for containers and packaging materials, he has contributed to the work of other organizations including the Technical Association of the Pulp and Paper Industry, and serves as the present chairman of the Joint ASTM-TAPPI Committee on Shipping Containers. Several universities have recognized his eminence in his field by invitation to participate in their packaging courses.

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To **Jerome Strauss**, Vice-President, Vanadium Corporation of America; chairman of ASTM Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys since its

## Annual Meeting Report

inception in 1929, for faithful and distinguished service, notably as the long-time chairman of A-10, and also as active worker in other phases of the Society's research and standardization activities.

His services have included administrative work as well, and he is a former Director. A leading authority in the field of metals, especially iron and steel and their alloys, he has carried out much pioneering work, in his services with industry and earlier as a member of the staff of the U. S. Naval Gun Factory. He served as treasurer of the Committee on Arrangements for the ASTM 50th Anniversary Meeting (1952), and this year is the Gillett Memorial Lecturer. He has participated actively in the work of many other organizations.

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To **Roderick B. Young**, Associate Director of Research, The Hydro-Electric Power Commission of Ontario, Canada, in recognition of pioneering work in concrete research which has contributed greatly to durability in concrete construction, and for his many years of service to ASTM through his committee activities, especially in Committee C-9 on Concrete and Concrete Aggregates, and his technical papers in the field of concrete.

A member of the Society since 1916, he has been active in Committees C-1 on Cement and C-9 since 1919. He was secretary of the Cement Committee for four years, and organized the C-9 Subcommittee on Ready-Mixed Concrete, heading the work of that group for 19 years. A Past-President and Honorary Member of the American Concrete Inst., he has received a number of honors recognizing his outstanding contributions to a better knowledge of cement and concrete, and control of their quality.



Walter A. Selvig



Erle I. Shobert, II



Earl R. Stivers



Jerome Strauss



Roderick B. Young

## **Annual Meeting Report**

### **1953 Medalists and Award Winners**

#### **Charles B. Dudley Medal**

This medal commemorating the Society's first president, is presented for a paper of outstanding merit constituting an original contribution on research in engineering materials.

- 1953 Award to E. A. Davis and M. J. Manjoine for their paper, "Effect of Notch Geometry on Rupture Strength at Elevated Temperatures."

**Evan A. Davis**, Westinghouse Research Laboratories, was born in Johnstown, Pa., and graduated from the University of Pittsburgh with a Mechanical Engineering degree in 1932. He has been with the Westinghouse Research Laboratories in East Pittsburgh since 1934 where he has been employed mainly on problems pertaining to the inelastic behavior of materials.

**Michael J. Manjoine**, Research Engineer, Westinghouse Research Laboratories, is a native of Muscatine, Iowa. He received his B.S. degrees in Mechanical and Electrical Engineering from Iowa State College and an M.S. degree from the University of Pittsburgh where he also held a fellowship sponsored by the Engineering Foundation of New York for the purpose of studying the influence of high strain rate on the plastic flow of metals at elevated temperatures. He has been with Westinghouse since 1940 and has had published a number of papers on the effect of strain rate on the plastic flow of metals and on creep-rupture testing.

#### **Richard L. Templin Award**

The purpose of this award is to stimulate research in the development of testing methods and apparatus, to encourage the presentation to the Society of papers describing new and useful testing procedures and apparatus, and to recognize meritorious efforts of this kind.

- 1953 Award to W. N. Findley, P. G. Jones, W. I. Mitchell, and R. L. Sutherland for their paper, "Fatigue Machines for Low Temperatures and for Miniature Specimens."

**William N. Findley**, Research Associate Professor of Theoretical and Applied Mechanics, University of Illinois, is a graduate of Illinois College, University of Michigan, and Cornell University. A contributor to several technical books and author of numer-



M. J. Manjoine

E. A. Davis



J. R. McDowell



W. N. Findley

P. G. Jones



W. I. Mitchell

R. L. Sutherland

ous papers in his field of plastics and creep and fatigue of metals, he received the Dudley Medal in 1945 for "Creep Characteristics of Plastics." He is very active in ASTM, serving on four main committees.

**P. G. Jones**, Associate Professor in Theoretical and Applied Mechanics, University of Illinois, has been on the teaching staff of the University since 1937 and received both his B.S. and M.S. degrees from Illinois. He is the author of several papers dealing primarily with the effect of speed of testing and brittle fracture.

**William I. Mitchell**, Stress Analyst, Boeing Aircraft Co., is a graduate of the University of Illinois (B.S. and M.S. Degrees) and has taught Theoretical and Applied Mechanics at Illinois and Iowa State College. He is at present on leave from South Dakota School of Mines and Technology where he is Assistant Professor of Civil Engineering.

**Robert L. Sutherland** was born in Fellsmere, Fla., and received his B.S. and M.S. degrees from the University of Illinois. Following several years in industry he became research associate at the University of Illinois. In 1948 he joined the mechanical engineering faculty of State University of Iowa, and is now Associate Professor of Mechanical Engineering.

#### **Sam Tour Award**

This award was established by Sam Tour to encourage research on the improvements and evaluation of corrosion testing methods and to stimulate the preparation of technical papers in this field.

- 1953 Award to J. R. McDowell for "Fretting Corrosion Tendencies of Several Combinations of Materials."

**J. R. McDowell** was formerly photoelastic technician at Carnegie Institute where he received his B.S. in Electrical Engineering. During World War II he served in the Air Corps. Since 1945 he has been with Westinghouse Research Laboratories and is now Research Engineer in the Mechanics Dept. where his work has dealt mainly with high-temperature creep of alloys, mechanical properties of insulating materials, and fretting corrosion.

## Sanford E. Thompson Award

This award is given for a paper of outstanding merit on concrete and concrete aggregates.

- 1953 Award to Mrs. Katharine Mather for "Applications of Light Microscopy in Concrete Research."

**Mrs. Mather**, Chief, Petrography Section, Special Investigations Branch, Concrete Research Div., Waterways Experiment Station, U. S. Army Corps of Engineers, Jackson, Miss., was born in Ithaca, N. Y., and is a graduate of Bryn Mawr College and Johns Hopkins University. Prior to 1942 she engaged in paleontological research and since that time has been Geologist and Engineer with the Corps of Engineers. Mrs. Mather is the author of a number of technical papers dealing with concrete research and application.

### Sessions

(Continued from page 12)

used as a measure of the thickness of the zinc coating.

A report of the B-3 Subcommittee on Weather indicates that samples of zinc or steel can be used to measure the relative corrosivity of the atmosphere at different test sites if average weight losses of yearly exposures are used. The relative degree of severity as determined by a single exposure could vary considerably with the average of several successive one-year exposures.

J. T. Richard's paper, "The Corrosion of Beryllium-Copper Strip in Sea Water and Marine Atmospheres," reports the results of corrosion tests on beryllium-copper and beryllium-cobalt-copper conducted in sea water. In addition to velocity and jet impingement action of sea water, temper, heat treatment, and edge condition of the alloy were investigated.

Committee B-7 discussed in some detail in an appendix to its report, the atmospheric exposure program which includes 27 aluminum and 8 magnesium alloys. Early data were also included in this report which was presented by L. H. Adam, Chairman of Subcommittee VIII on Atmospheric Exposure Tests.

### Symposium on Electron Metallography Techniques

A VARIETY of techniques were described in a lively, two-session symposium presented Tuesday. The always ingenious, sometimes simple, sometimes intricate "ways of doing it" disclosed by fifteen authors and co-authors must have had strong appeal to the professional interest of the scientists looking on. There was no "sleeping in class." The techniques—most were new; some were old with a



Katharine Mather

new "twist." Following each presentation, sprightly discussions developed which added to the store of knowledge in a still relatively new field of science.

Adding a chunk to the store of knowledge was probably the most important background reason for the symposium's presentation by Committee E-4 on Metallography. The sessions were a logical development of results obtained for the various progress reports of Subcommittee XI on Electron Microstructure of Steel which have been assembled at intervals since 1951. Many techniques have been sought out, used, retained, or discarded in the subcommittee's attempts to best bring out the secrets of the microstructure of steel. Realizing the potential value of a compilation of techniques on preparation, mounting, and washing of metallic specimens, some of the subcommittee's results were organized by Committee E-4 into the present symposium. Present plans will make available the papers listed below combined as an ASTM special technical publication (STP):

- Introduction—C. M. Schwartz, Battelle Memorial Institute.
- Techniques Used in Electron Microscopy of Aluminum Alloys—F. Keller and M. S. Hunter, Aluminum Company of America.
- Techniques for the Study of Precipitated Carbides—W. D. Forgeng and John L. Lamont, Union Carbide & Carbon Research Laboratories, Inc.
- Inorganic Replication: Interpretation of Electron Micrographs—C. J. Calbick, Bell Telephone Laboratories, Inc.
- Electron Microstructure of Steel by Extraction Replica Technique—R. M. Fisher, U. S. Steel Corp.
- Metal-Shadowing for Contrast Enhancement—Comparison of Shadow Metal and Shadow Angle—D. M. Teague, Chrysler Corp.
- Specimen Polishing Techniques for Electron Metallography of Steel—W. L. Grube and S. R. Rouze, General Motors Corp.
- Techniques Which Permit Successive Examinations of Specific Areas by Electron Microscopy—E. A. McLauchlan, U. S. Steel Co.
- Replica Washing Methods—E. F. Fullam, General Electric Co.
- Determination of Surface Properties for Eutectoid Steel and Iron as Prepared by

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the Conventional Metallographic Techniques of Abrading, Mechanical Polishing, and Chemical Etching—C. F. Tufts, Sylvania Electric Products, Inc.

Application of New Etchants for Delineation of Fine Structure in Steel—Alfred E. Austin, Battelle Memorial Institute.

Positive versus Negative Plastic Replicas—C. M. Schwartz, Battelle Memorial Institute.

### Symposium on Porcelain Enamels and Ceramic Coatings as Engineering Materials

PORCELAIN enamels and ceramic coatings as engineering materials was the theme of a two-session symposium. This symposium was sponsored by Committee C-22 on Porcelain Enamel, with fifteen papers included in the program which occupied two sessions.

There was general interest shown in all fields of porcelain enamel and ceramic coating application but it was evident from the considerable discussion that the established possibility of obtaining metal protection from a wide variety of corroding or abrading agents, while at the same time maintaining an easily cleaned and lustrous surface, was an attractive one, and that the obviously effective protection from heat and fluid corrosion, offered to industrial metal by the subject coatings, was of immediate interest.

The Symposium was so arranged that in an introductory paper the various useful fields of application were specifically reviewed. In a final summary paper, based on the context of the program, it was shown how porcelain enamels and ceramic coatings by formulation and application techniques can be adapted to serve most effectively in a wide variety of end point uses. In addition to this direct reference was made to the various agencies wherein prospective users can get information and help with their particular problems.

The introduction paper "Some Examples of the Functional Use of Porcelain Enamel and Ceramic Coatings for Steel," by G. H. Spencer-Strong, Pemco Corp., discussed various properties, including surface hardness, chemical resistance, thermal resistance, electrical properties, mechanical properties and optical properties. The author pointed out the importance of selection of suitable porcelain enamels and ceramic coatings for functional end uses, as is the case with any other engineering material.

D. G. Moore, National Bureau of Standards, presented a paper entitled "Resistance of Porcelain Enamels to Weathering." A large number of 1-ft square porcelain enameled panels of



A Number of Prominent ASTM Men Gathered at the Head Table for the President's Luncheon Session of the Annual Meeting Held on Tuesday Afternoon. From left to right: R. E. Hess, Associate Executive Secretary; Jerome Strauss, Gillett Lecturer; E. J. Albert of the Philadelphia District who were hosts of the meeting; Past President

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varying types were exposed for seven years at three different locations. Good correlation existed between acid resistance and the percentage of initial gloss retained. Considerable corrosion of those parts of the panels that were incompletely covered by enamel was evident under salt-air conditions. Most porcelain enamel finishes are highly resistant to deterioration under the conditions existing at the selected locations.

A paper by E. A. Sanford and O. J. Britton, The Pfaudler Co., entitled "The Chemical Resistance of Glass Fused to Steel," discusses the conditions of use in the chemical industry and the use of glassed steel with particular chemicals such as sulfuric acid, nitric acid, and alkali. H. C. Wilson, Vitreous Steel Products Co., also discussed acid-resisting properties of porcelain enamels in a paper under that title. Mr. Wilson concluded that the conditions of exposure such as temperature, concentration, etc., should be determined and presented to the ceramic engineer, who would then recommend the enamel to meet these requirements.

Several papers dealt with high-temperature ceramic coatings. The first of these papers was entitled "Requirements for and Expected Benefits from the Application of Coatings to High-Temperature Components of a Jet Engine," by A. C. Francisco and G. M. Ault, National Advisory Committee for Aeronautics. The requirements for all types of coatings include refractoriness, resistance to erosion by high velocity hot gases, and good adherence under large thermal gradients and severe thermal shock.

A paper on the "High-Temperature Ceramic Coatings as Applied to Aircraft Power Plants" by B. L. Paris, Wright Air Development Center, summarized the accepted benefits to be derived from

the use of high-temperature ceramic coatings by both industry and the Armed Forces. This summary included the expectancy that ceramic coatings can and will be successfully used in aircraft power plants, providing the designer takes into consideration the limitations as well as the inherent advantages that can be realized by their usage. The use of high-temperature ceramic coatings by industry is felt to be a practical and economical step.

Sara J. Ketcham, Naval Air Material Center, in a paper entitled "A Laboratory Evaluation of Ceramic Coatings for High-Temperature Applications," reviewed test methods employed in an investigation which proved useful in distinguishing coatings of decidedly superior or inferior behavior. The use of metallographic techniques was stressed, as well as microscopic studies, coupled with weight change data. The final paper in the group on high-temperature ceramic coatings, "The Industrial Processing of High-Temperature Ceramic Coatings," by J. H. Terry, Hotpoint, Inc., reviewed procedures used in metal and coating preparation, application, drying, and firing of the heat-resistant finish to aircraft parts. The lessons learned in processing these materials have shown that careful production operations will result in coatings that will protect valuable alloy parts and extend their life many times.

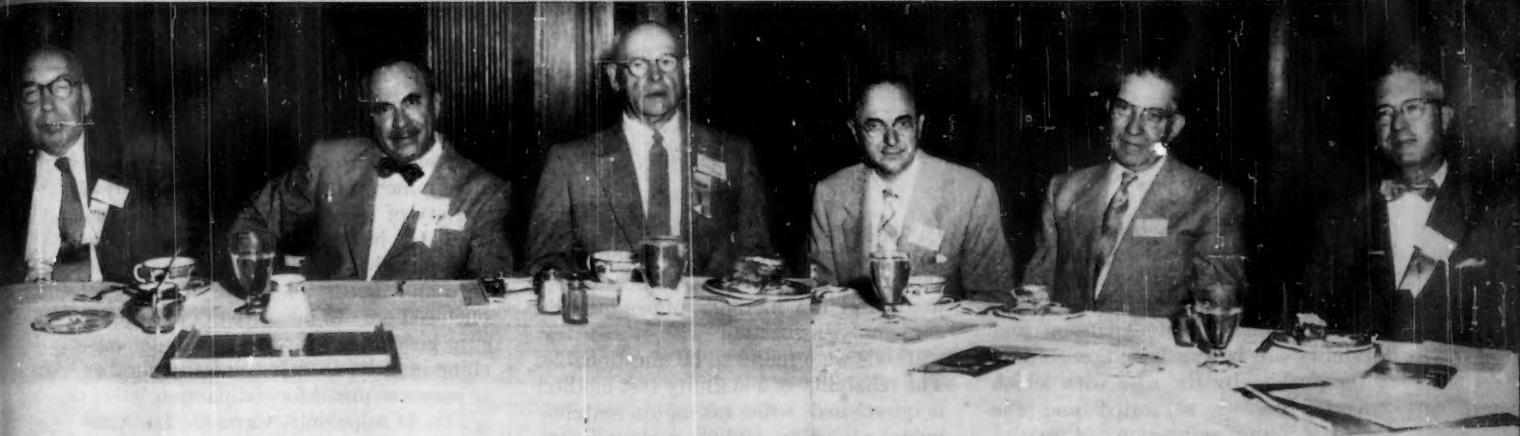
Abrasive resistance was discussed in two papers, one entitled "Abrasion Resistance of Various Types of Porcelain Enamel," by A. V. Sharon, Chicago Vitreous Enamel Product Co., and the second entitled "The Resistance of Porcelain Enamels to Surface Abrasion as Determined by the P.E.I. Test," by John T. Roberts, Crane Co. The Sharon paper described the use of the Taber Abraser in measuring the abrasion resistance of several types of porcelain enamels. The titanium opacified

enamels proved to have the greatest wear resistance. The author concluded that field service experience was predictable on the basis of the Taber Abraser results. Mr. Roberts outlined the study now being made in ASTM Committee C-22 for a standard test method on abrasion. Attention is being centered on the test procedure originally developed by the Porcelain Enamel Inst. Porcelain enamels, by virtue of their hardness should satisfactorily withstand the abrasive action of practically any type of free moving particle moving over its surface under a weighted soft applicator or object.

"Torsion Testing as an Aid to the Porcelain Enamel Industry" was the title of a paper by E. L. Hoover, Westinghouse Electric Corp. A torsion testing program was described, which covered four areas of control, namely, incoming materials control, process control, packaging problems, and special tests. It was concluded that torsion testing has made possible the development of one coat enamel direct on steel and has accelerated the over-all enamel program.

Information indicating that porcelain enamel will produce a definite stiffening effect was given in a paper by E. E. Bryant, Ferro Corp., entitled "The Strengthening Effect of Porcelain Enamel on Sheet Iron as Indicated by Bending Tests." The author concludes that the load supported, before exceeding the yield point, is greatly increased by the enamel applied on the compression side, with deflection at the yield point not being changed. Enamel applied on the tension side produces a slight increase of load supported, before exceeding the yield point, with a definite decrease in deflection at the yield point being noted. A further paper by W. A. Deringer, A. O. Smith Corp., discusses "Tension Tests of Porcelain Enamelled Steel." It was found that the rate of pulling affects the critical strain, or elongation, required to cause cracking.

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J. G. Morrow; C. H. Fellows, newly elected Vice President; H. L. Maxwell, retiring President; Past President T. S. Fuller; L. C. Beard, Jr., incoming President; H. H. Lester, Honorary Member; F. D. Rossini, Marburg Lecturer; H. M. Hancock, Philadelphia District; R. J. Painter, Executive Secretary.

Glass cracks at a definite strain and is not affected by the strength of the base metal. The fact that a porcelain enamel or glass coating will not crack or chip from the enameling iron base unless the yield point has been reached or exceeded has been very useful.

The electrical resistivity is discussed in a paper entitled "The Effect of Temperature on the Electrical Resistivity of Several Ceramic and Silicone-Type Coatings" by Simon W. Strauss, L. E. Richards, and D. G. Moore, National Bureau of Standards. Ceramic and silicone-type coatings were used and their electrical resistivities were compared with those obtained for sheet mica. The ceramic-type coatings, because of their much greater physical and chemical stability at elevated temperatures, would prove preferable as electrical insulating materials since they would have a longer life expectancy than either mica or silicone-type coatings.

#### Sessions on Concrete, Mortar, and Asphalt Paving Mixtures

**Concrete.**—The significance of tests of concrete was the theme of the 18th Session held on Tuesday evening, June 30 and attended by a good sized audience. The subjects covered by six papers discussed new fields of relatively unexplored concrete testing.

In "The Significance of Pore Characteristics of Aggregates and Porosity Determinations," W. L. Dolch indicated that it would be difficult to prove that any other physical property is of greater importance than the porosity characteristics of either natural or artificial aggregates. Pore characteristics of a coarse aggregate not only influence the durability properties of concrete but also the potential chemical reaction. The co-authors of this paper with Dolch were K. B. Woods and D. W. Lewis, all of Purdue University. Written and verbal discussion of this paper

also emphasized the importance of a complete knowledge of pore characteristics.

"The Significance of Tests for Chemical Reactions of Aggregates in Concrete," by William Lerch, Portland Cement Assn., described the progress which has been made in developing methods of tests for aggregates to determine their potentialities of producing deleterious chemical reactions in concrete. An urgent need for further study of test procedures was stressed to provide assurance that the reactive material is not present in the proportion required to cause abnormal expansion.

Tests on sulfate resistance of concrete have a significance, according to E. C. Higginson, who co-authored a paper with O. J. Glantz, U. S. Bureau of Reclamation. A significant conclusion made was that increasing the cement content of concrete increases its sulfate resistance, also that entraining air in concrete does not always increase its resistance to sulfate attack.

The resistance of concrete to abrasion or wear has long been discussed. A paper by H. L. Kennedy, with M. E. Prior, both of Dewey & Almy Chemical Co., described the types of wear tests that have been investigated. Four general categories of abrasion tests were described: a rubbing action with the wear caused by the introduction of foreign particles; a second type of rubbing action which includes an impact-cutting type of wear; a cutting action whereby abrasive particles are carried by liquid against the concrete; and a fourth type of wear which is completely an impact abrasion, corresponding to cavitation erosions. The authors have indicated that there is no one method of test for abrasion resistance which can satisfy all conditions. Two types are recommended for further study, namely, the shot blast and rubbing, and the

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shot blast and dressing wheel types of test.

Nondestructive testing of concrete is being increasingly used, and a paper by W. E. Parker, Hydro Electric Power Commission of Ontario, discussed a phase of this type of testing. The use of the soniscope is described, showing the fields of greatest usefulness, as well as limitations that have been encountered. It is shown that pulse velocity techniques offer many opportunities for the rapid nondestructive testing of concrete, either in the laboratory or in field structures.

The desirable characteristics of curing compounds for portland-cement concrete were evaluated by C. E. Proudley, North Carolina State Highway and Public Works Commission. Need was expressed by the author for standard methods for determining moisture loss through membranes; he further stressed that no adequate method for detecting the deleterious effect which a liquid compound may have on the concrete has been developed. In the field, there is need for more data which will indicate the effect which the methods of curing have on structures and pavements.

A group of papers in the general field of concrete and paving mixtures were presented as part of the 24th Session on Wednesday, July 1.

The effect of characteristics of sieve analysis of sands used in mortar was described by C. C. Connor, New Jersey Bell Telephone Co. Workability and joint cracking are associated in this paper with sieve analysis characteristics. New grading requirements for sands for masonry mortar, based primarily upon the ratio of percentages between successive pairs of sieves in the sieve analysis, were presented as an improved method of judging the suitability of sands.

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L. J. Mitchell, U. S. Bureau of Reclamation presented information on thermal expansion tests on aggregates, neat cements, and concretes. The thermal coefficients of expansion and durability are both affected, according to the author, by the ease with which concrete becomes saturated and the degree of actual saturation. A second paper on this subject, entitled "Prediction of Concrete Durability from Thermal Tests of Aggregate" was presented by E. C. Higginson, U. S. Bureau of Reclamation. Co-author of this paper was D. G. Kretsinger, also of the Bureau of Reclamation. The test series data referred to in this paper indicated that there is no uniform trend with respect to direct dependency of durability on the thermal properties of the aggregates. The measurement of thermal coefficients of saturated concretes are shown to provide the means for predicting the freezing-and-thawing durability of concrete containing various types of aggregates.

The use of sonic methods in determining the compressive strength of concrete is covered in a paper by C. E. Kesler and Y. Higuchi, University of Illinois. The authors concluded that if the curing conditions are the same, a logarithmic decrement decreases with an increase in age; it decreases as the moisture content of a specimen decreases. Furthermore, the logarithmic decrement, if used alone, is not a measure for concrete strength. Another paper describing the use of the sonoscope is that by G. M. Batchelder and D. W. Lewis, Purdue University, entitled "Resonant Frequency and Velocity Tests on Concretes Subjected to Freezing and Thawing." It was found that in general no benefit is derived from calculating modulus of elasticity values from velocity measurements. In discussion of this paper, it is pointed out that in dynamic testing, numerical values obtained in one method of test need not agree closely with those obtained in a different way. Both methods provide useful information.

**Asphaltic Pavements.**—A departure from a field of portland-cement concrete to that of asphaltic paving mixtures was found in the final paper of the session, entitled "An Investigation of Design Methods for Asphaltic Pavements." B. A. Vallerga, University of California, and Ernest Zube, California Division of Highways, were co-authors of this paper. This paper makes a comparison between pavement design methods and stability test methods of a dense-graded, plant-mixed

paving mixture. The Marshall, Hubbard-Field, Direct Compression, and the Smith Triaxial Cell equipment were used, and the methods of compaction commonly associated with these test methods were found to be questionable. The reliability of a stability test method is questioned, when maximum stability values are at an asphalt content in excess of 5 per cent.

### **Symposium on Dynamic Testing of Soils**

THE symposium on Dynamic Testing of Soils posed the question "What would we like to know about soil dynamics?", in an effort to assemble available information and discuss the unsolved problems in Soil Dynamics.

This Symposium (as well as the one on Lateral Load Pile Tests) is the result of a continuing active program of Committee D-18 on Soils for Engineering Purposes to encourage each research subcommittee to sponsor a symposium in its particular field. The Committee has been well aware of the difficulties involved in the development of standards in the field of soil mechanics and of the need for much research aimed at resolutions of these difficulties. Already, the Committee has sponsored the Symposia (1) On the Identification and Classifications of Soils (STP 113), (2) On Triaxial Testing (STP 106), (3) On Surface and Subsurface Reconnaissance (STP 122), (4) On Consolidation Testing of Soils (STP 126), and (5) On Direct Shear (STP 131).

The Symposium was divided into two sessions which presented the dynamic testing of soils from the point of view of physical considerations in the first session and from the mathematical standpoint in the second.

"Elasticity and Damping of Oscillating Bodies on the Soil," by H. Lorenz pointed out that the discrepancies between the simplified theory of soil acting as a linear spring are too large to be used with any degree of success for large machine installations. Experimentally determined resonance curves show that the introduction of the theory of nonelastic behavior of soil should be introduced to obtain adequate solutions. Such behavior increases the mathematical difficulties but workable graphs and approximations can be developed.

In the second paper, "The Pressures Generated in Soil by Compacting Equipment," A. C. Whiffin, Road

Research Laboratory, England, utilized piezoelectric quartz pressure gages to determine the pressures generated by a variety of rollers, rammers, and a tractor. He has shown that once having determined a relation between pressure and density, for a particular soil, one need only to measure the peak pressure generated by the compacting machine in order to determine the number of passes required for compaction.

Elio D'Appolonia, Carnegie Institute of Technology, described in his paper "Loose Sands—Their Compaction by Vibroflotation" the process of vibroflotation in which a large tube, containing an eccentric weight and a water source, vibrates and saturates an area of clean, pre-draining granular solid into a condition of greater compaction. As the sand reaches greater compaction, greater power is necessary to operate the vibrator and thus the density of the soil may be correlated to the ammeter readings. This process is unique in that compactions may be carried out at any desired depth.

Gregory P. Tschebotarioff, Princeton University, found a dearth of information for his paper on the "Performance Records of Engine Foundations." From the evidence that was available, the author was able to construct a plot showing the relationship between the area and natural frequency of a foundation, which may indicate points of possible danger for particular soils. The author proposed a record sheet form which would be desirable for all cases of engine foundations as an aid to the soils engineer.

It is the opinion of Hans F. Winterkorn, Princeton University, in his paper on "Makromeric Liquids," that the mass activity of soils can be taken as that of an indefinitely extended liquid. The author pointed out that soils have the same randomness, and, although lacking the equivalent of intra-molecular forces, may approach the liquid state by the application of vibratory pressure. From the development of the foregoing assumptions the author reached the conclusion that the amplitude of the vibration should be of the same order of magnitude as the particle size, the frequency should be low enough to allow the particles to assume

### **To Members . . .**

There are still some preprints of Annual Meeting papers available which members who did not receive copies may obtain by writing to Headquarters.

positions of lower potential energy and the vibration mechanism should be as heavy and cover as much area as possible.

"Pilot Studies on Soil Dynamics" by R. K. Bernhard, Rutgers University, and J. Finelli, Stevens Institute of Technology, showed that pressure cell indications and surface settlement cannot replace measurements of density or shear resistance. Grain size distribution of the soil must be accounted for to obtain maximum possible density. Maximum compaction, shear resistance, and stabilized soil are not necessarily identical; therefore, further studies in the field are essential.

By the use of a simple experimental setup, the authors were able to compute damping, viscosity, and shear modulus of soils. However, it was found that computations could not be based upon the theory which allows only one degree of freedom. The mathematical model had to assume slippage in order to be consistent with the experimental results.

Most empirical methods have limited applications, but it seems that an approach similar to Reissner's development is required, with the addition of factors for the internal friction and nonhomogeneity of the soil. To be of practical value, however, convenient methods for the measurement of Poisson's ratio, shear modulus, density, and their variation with depth, must be found.

F. J. Converse, California Institute of Technology, presented, "Compaction of Sand at Resonant Frequency." The Caltech vibrator was rigged in a sand pit and operated at gradually increasing frequencies. It was found invariably that the vibrator developed a violent motion at the resonant frequency at which point large permanent settlements occurred. By measuring the vibrator settlement it was possible to determine the resonant frequency within  $\pm 25$  cycles. Density measurements of the soil were made to corroborate all results. The author concluded that the operation of a vibrator at resonant frequency was the key to the problem of obtaining the maximum compaction of sand. Such frequencies can be determined by consideration of the elastic constant of the soil and the physical properties of the vibrator. With proper oscillator design and operation, effective compaction can be obtained in sand to a depth of about twice the width of the oscillator.

"The Elastic Theory of Soil Dynamics," presented by Patrick M. Quinlan, University College, Cork, Ireland, reviewed the mathematical formulations which the author utilized to develop a

theoretical treatment of elastic vibration in soil. The author also treated the problem of settlement of the surface which is produced when the compaction caused by the oscillator is at a maximum. Further development of the above is shown to lead to the graphical determination of Poisson's ratio, modulus of rigidity, and density, *in situ*, by measuring the power input into the oscillator at the resonance point.

Adrian Pauw, University of Missouri, in his paper, "A Dynamic Analogy for Foundation-Soil Systems," discussed his progress in formulating a method of analysis. Assumptions, spring factors, mass factors, foundation motion, and natural frequency were dealt with and presented in graphical form to permit rapid calculation of soil behavior. The work presented has had excellent correlation with observed behavior of cohesionless soils, but more information is necessary to confirm its accuracy in regard to cohesive soils.

In the presentation of his paper, "A Discontinuous Model for the Problems of Soil Dynamics," J. J. Slade, Rutgers University, stated "we are well aware of the activity of the soil mass at semi-infinity, and we shall be able to compute exactly what energy we put into the soil by the oscillating mechanism. Thus our only problem should be computing the soil activity from the known oscillating source to the known activity at semi-infinity." However, many investigators have found anomalous frequency responses in their measurements, and the author points out that these may be due to the elasticity of the oscillator's parts. Thus the complete activity of the machine should be thoroughly studied before serious attention is given to the results obtained from the soil study. The author further described a discontinuous model which may be used as a schematic guide for computing the complex characteristics of soil.

The main object of the paper, "Vibration in Semi-Infinite Solids Due to Periodic Surface Loading," by Tse Yung Lung, Harvard University, was to find the critical frequency of a foundation when a group of vertical harmonic pressure forces acted upon the foundation surface, the "critical frequency" being that frequency at which the mean amplitude of the vertical displacement underneath the base plate is a maximum. The author developed his analysis to include the construction of a series of curves whereby the variables of the oscillator and foundation loading once determined may be

used to evaluate the elastic constants of the foundation system. These elastic constants may then be used to compute the critical frequency, amplitude of oscillation, and the power requirements for a wide range of oscillator-foundation combinations.

### **Symposium on Lateral Load Pile Tests**

A PROBLEM that often occurs in the design of pile foundations concerns the ability of the piles to resist lateral force applied at the pile heads. This two-session symposium was sponsored by Committee D-18 on Soils for Engineering Purposes for the purpose of gathering together the data resulting from field tests on full-sized piles and laboratory tests on model piles that have been made over a period of years. It is the expectation of the committee that the material presented may lead to the development of a standard procedure for making tests of this type.

The first paper, by G. A. McCammon and J. C. Ascherman, of the Creole Petroleum Corp., describes a series of tests on "Resistance of Long Hollow Piles to Applied Lateral Loads" which were made at Lake Maracaibo, Venezuela. The tests indicated that the plastic clay into which hollow piles had penetrated acts as an elastic medium in resisting lateral forces; also, the point of maximum movement occurs very near the surface of the soil, even though the soil penetration is large.

Two papers discussed tests made by the Corps of Engineers in connection with the construction of a lock in the Mississippi River. One of these papers, presented by L. B. Feagin, gave the results of tests for determining for design purposes the relative resistance to lateral loads of various arrangements of groups of battered and vertical piles. The tests included lateral loads applied both in the direction of the pile batter and in the opposite direction, with and without vertical load. The second paper, by S. M. Gleser, described tests made on a monolith capping seven vertical wood piles, and a hollow steel pile subjected to vertical and lateral loads, in which, by means of special instrumentation, the deflections throughout the length were measured.

Professor G. P. Tschebotarioff of Princeton University described a series of tests made on small model replicas of single piles and 3-pile and 7-pile dolphins. These showed that the resistance of a pile to lateral loads decreases

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appreciably with an increase in the number of piles in a group. The tests showed further that considerable bending stresses are engendered in the piles at the outer boundary of the group, so that conventional procedures of structural analysis which ignore such interaction between the soil and the individual piles of a laterally loaded pile group should be revised.

A paper by A. A. Wagner of the Bureau of Reclamation presented the results of lateral load tests on timber piles conducted by the Bureau of Reclamation for design purposes. Results of tests were presented which had been performed in loess soil in Nebraska, saturated sand and silt in the Delta area of the Sacramento and San Joaquin Rivers in California, stiff clay and silt in Arizona, and glacial till in Alaska. Based upon these, general conclusions and recommendations are given.

A paper on "The Lateral Load Capacity of Timber Pile Groups," by J. O'Halloran of the Anglo-Canadian Pulp and Paper Mills, Ltd., presented the results of a series of tests conducted some years ago (but never published) in connection with the construction of a wharf for a large newsprint mill upon the north bank of the St. Charles River in Quebec City. Pile groups were needed for restraining movement of a timber crib structure. Careful records were made, and the paper presents these in summary form.

A paper by L. T. Evans, Foundation Engineer, Los Angeles, on "Bearing Piles Subjected to Horizontal Loads" was presented by F. J. Converse of California Institute of Technology. This paper presented the data from a very comprehensive report by the Los Angeles District of U. S. Engineers in 1940. The project was not undertaken as a basic research problem but provided all of the information required to design the structure.

### **Session on Plastics**

IN ADDITION to the reports of Committee D-20 on Plastics and Committee D-9 on Electrical Insulating Materials, two papers of particular significance were presented. The one by R. K. Witt and W. H. Hopmann and R. S. Buxbaum of Johns Hopkins University dealt with the theoretical basis and an experimental method for the determination of elastic constants by measuring deflections of a thin plate subject to couples on its boundary. Constants were determined for glass

melamine, glass silicone, and paper-base phenolic laminates.

The second paper, by S. E. Yustein and R. R. Winans of the New York Naval Shipyard, and H. J. Stark, Bureau of Ships, represented a further report (following up an earlier paper on the subject) on outdoor weather aging of various types of plastics and presented results after three years' exposure. Five climatological regions are represented in the program which provides for outdoor exposures in tropical, desert, temperate, subarctic, and arctic climate. Various mechanical, electrical, and optical properties were evaluated. On the basis of the extensive data accumulated, it is possible to deduce the occurrence of a variety of effects that appear to be related to differences in climatic and environmental conditions.

### **Session on Bituminous Waterproofing and Roofing Materials**

THREE papers were presented as a special feature of the meeting of Committee D-8 on Bituminous Waterproofing and Roofing Materials. Two of these papers discussed bituminous films. A paper entitled "Preparation of Bituminous Films by Spinning," by L. R. Kleinschmidt, National Bureau of Standards, described the preparation of test coatings, by a spinning process, of asphalts, coal-tar pitches, and other solid materials not having fixed melting points. The principal value of this method was pointed out to be the case whereby a large number of specimens differing in small increments of thickness can be quickly prepared from small amounts of material. A second paper bearing the title of "A Method of Preparing Uniform Films of Bituminous Materials," by S. H. Greenfeld, National Bureau of Standards, presented results of the use of a hydraulic press in the preparation of uniform films of both stabilized and unstabilized bitumens for exposure out-of-doors and to accelerated durability tests. It was possible to obtain, consistently and rapidly, panels with a maximum variation of  $\pm 0.001$  in. with fewer than 10 per cent rejections.

The third and final paper, "Effects of Thermal Shock on the Durability of Asphalt Coatings Under Accelerated Test," was also written and presented by S. H. Greenfeld. The introduction of thermal shock into an accelerated weathering test procedure was described. This was accomplished by the introduction of a chilled water spray

for 3 min every 20 min in the test cycle using the weatherometer. Two of the four panels with each coating were also exposed to air at  $-5^{\circ}\text{F}$  for 2 hr daily. It was found that exposure to air at  $-5^{\circ}\text{F}$  has no significant effect on the durability or failure pattern of both stabilized and unstabilized asphalts under accelerated tests if the test includes frequent cyclic thermal shocks.

### **Session on Atmospheric Sampling, Water, and Simulated Testing**

COMMITTEE D-22, one of the younger committees of the Society (organized in 1951) while not holding a formal session on atmospheric sampling, did sponsor three papers in this field. One of the three papers (W. J. Smith and N. F. Suprenant of Arthur D. Little Co.) dealt with the properties of various types of air filtration media for particulate matter with particular attention to flow resistance characteristics, particle penetration, and physical and chemical properties as related to sampling needs. A second paper (Morris Katz, National Research Council of Canada) on instrumentation and analytical techniques, although pointing out that the fact that many of the techniques are in the early stages of development, discussed four major types of instruments relating to (a) meteorology, (b) gaseous contaminants, (c) aerosols, and (d) light transmission.

The third paper (J. D. Sensenbaugh and W. C. L. Hemeon, Industrial Hygiene Foundation) which presented factors significant in obtaining satisfactory dust fall measurements included a method for classifying data to permit valid comparison of results from different cities and offered recommendations for a standard procedure.

This session also included a paper on the results of an investigation of several methods of testing for dissolved oxygen in a high-purity water. Methods studied were the referee methods, ASTM's Tentative Methods of Test for Dissolved Oxygen in Industrial Water (D 888) and the Schwartz-Gurney B procedure with dead stop, potentiometric, and starch titrations.

S. A. Gordon of Battelle presented in interesting fashion, the "Philosophy of Simulated Service Testing." He concluded the case for the simulated service test where the environment and product operation influence life as follows: (1) A complete knowledge of both the product and its environment must be known. (2) A false sense of security must be avoided in component testing. (3) Care must be exercised in selecting the most important environmental variables, and (4) Practically

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no laboratory test on small specimens will be of direct value in predicting life for structure.

### Symposium on Fluorescent X-ray Spectrographic Analysis

As a result of the current revival of interest in fluorescent X-ray spectrographic analysis, Committee E-2 on Emission Spectroscopy sponsored a six-paper symposium on this subject. The papers included one on basic theory and fundamentals; one on general aspects of analytical applications; three papers on specific fields of application of the technique to metallic materials, minerals, and stainless steels; and a paper on multichannel recording in X-ray fluorescent analysis.

An attentive audience of about 120 and active discussion gave evidence of intense interest in current developments in this field of analysis. In the papers and discussion the consensus appeared to be that fluorescent X-ray spectrographic analysis should be regarded as a promising supplement—not as competition—to current an-

alytical methods such as the more common spark and arc methods of emission spectrochemical analysis. X-ray spectrographic analysis has proved particularly successful in the analysis for elements of higher atomic numbers.

It is expected that the complete symposium will be published later this year.

### Symposium on Radioactivity in ASTM Work

AT TWO sessions sponsored by Committee E-10 on Radioactive Isotopes on June 30, six papers, followed by a panel discussion, comprised a symposium which pointed out quite clearly the potentialities of radioisotopes for testing and measurement. In addition, a demonstration period was used to illustrate typical applications of radioisotopes in industry and an AEC movie on "Methodology" was shown. Representative instruments and equipment were exhibited in conjunction with the symposium. A great deal of

interest was indicated by an audience of 175 during a period when many activities were held simultaneously.

Although no publication was planned previous to the symposium, the papers and discussion were so enthusiastically received that an attempt will be made to gather all the material available and print it.

The papers with their respective authors were:

Properties and Uses of Radioisotopes—  
G. D. Calkins, Battelle Memorial  
Institute

Applications of Radioactive Measurements  
to ASTM Work—O. M. Elliott, Sun  
Oil Co.

Design of Radioisotope Laboratories—  
G. G. Manov and O. M. Bizzell, U. S.  
Atomic Energy Commission

Training Personnel in Radioisotope Techniques—Donald R. Smith, Oak Ridge  
Institute of Nuclear Studies

Instrumentation—E. H. Wakefield, Radiation  
Counter Laboratories

Management Problems Resulting from  
Radioisotope Utilization by Industry—  
W. L. Davidson, U. S. Atomic Energy  
Commission

## COMMITTEE ACTIVITIES

### A-1 on Steel

Since 1950, Committee A-1 has been coordinating the views of its various subcommittees on definitions and methods for the mechanical testing of steel products. Originally this work was not expected to be completed before 1955. However since the 1952 Annual Meeting many of the members have spent extraordinary amounts of time on the project. The result has been a coordination of many divergent views on the production testing of steel products. At the 1953 Annual Meeting the Tentative Methods and Definitions for the Mechanical Testing of Steel Products (A 370 - 53 T) were approved for publication. The document covers tension, bend, hardness, and impact testing and includes two supplements describing special tests for bar and tubular products. It is expected that other supplements will be added as they are developed. For instance, a supplement covering special tests for bolting materials is now under way.

Other significant developments were the publication of two new specifications for sheet steel: Tentative Specifications for Commercial Quality Cold-Rolled Carbon Steel Sheet and Tentative Specifications for Cold-Rolled Carbon Steel Deep-Drawing Sheet, Special Killed for Miscellaneous Drawn or Severely Formed Parts.

Chairman N. L. Mochel of the Westinghouse Electric Corp. announced his resignation at the Annual Meeting. Mr. Mochel has been elected as Senior Vice-President of the Society. H. B. Oatley, presently chairman of the Boiler Code Committee of The American Society of

Mechanical Engineers, was elected to fill the vacancy in the chairmanship until June of 1954.

Producer Vice-Chairman T. G. Stitt of the Pittsburgh Steel Co. also resigned because of retirement. Since Mr. Oatley had been acting as Consumer Vice-Chairman previous to this meeting, the offices of Consumer and Producer Vice-Chairmen were left vacant. W. F. Collins, New York Central System, and C. E. Loos, U. S. Steel Corp., were elected as Consumer Vice-Chairman and Producer Vice-Chairman, respectively.

### A-3 on Cast Iron

To determine the chilling tendencies of cast iron, Committee A-3 has written the

Tentative Methods of Chill Testing of Cast Iron. These methods apply to gray irons which are to be free of chill in the casting and to chilled irons which are to have a specified depth of chill in the casting. A wedge test generally better adapted to the higher strength gray irons and a chill test better adapted to the softer grades are covered. In the wedge test the accelerated cooling rate to induce formation of chill is brought about through the design of the test specimen. The chill in the chill test is induced by casting one edge of the test specimen against a metal or graphite chilled plate or block.

### A-5 on Corrosion of Iron and Steel

The investigation of non-destructive



Members of Committee D-2's Research Division III. In the usual order: F. D. Tuemmler, C. H. Lynam, C. M. Gambrill, W. J. Troeller, Jr.

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methods for the determination of thickness of metallic coatings using magnetic gages is continuing. The committee has also been interested for many years in the Preece test, and a report prepared by Messrs. Ellinger, Orem, and Pauli is appended to the current A-5 report.

The Subcommittee on Wire Specifications is initiating work on the preparation of specifications for zinc-coated armour wire and for zinc-coated poultry and turkey run netting.

New work within the committee includes the study of a recommended practice for safeguarding against warpage and distortion during hot-dip galvanizing of steel assemblies, also a specification for zinc-coating (hot-dip) on miscellaneous fabricated or assembled steel products. Results from a questionnaire sent to the A-5 membership and to a subcommittee of the Edison Electric Institute indicate that 29 are in favor of a new hardware test and the committee is prepared to go ahead on this basis.

Appended to the A-5 Report is the biennial report of Subcommittee XV on Atmospheric Exposure Tests of Wire and Wire Products.

A special group has been set up within the Advisory Subcommittee to decide which of the A-5 specifications and methods of test should be submitted to the ASA for approval.

### **A-6 on Magnetic Properties**

Four active task groups are working on (a) specifications for electrical sheet and strip, (b) normal variability of magnetic properties and of electrical sheet, (c) a manual of magnetic testing to supplement the standard testing specifications, and (d) a thorough-going revision of the specifications for a-c testing.

The committee regrets the loss (due to resignation of Western Union from the committee), of R. C. Taylor as its secretary but is pleased that Milan Getting, Jr., of Allis-Chalmers has agreed to take on these duties.

### **A-7 on Malleable Iron**

Intensive consideration is being given by Committee A-7 to impact testing of the various types of malleable iron through the use of 0.505-in. diam cantilever type specimens. The work is progressing, with normal, subnormal, and elevated temperatures being involved.

### **A-9 on Ferro Alloys**

The steel industry has pointed out to Committee A-9 the extreme difficulty encountered in meeting the requirement for 78 to 82 per cent manganese in the 7.5 per cent max carbon grade of ferromanganese in Specifications A-99. To meet present conditions a new grade of ferromanganese has been added, requiring 74 to 78 per cent manganese with impurities the same as for the 78 to 82 per cent grade.

### **A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys**

The committee has fulfilled a long-felt need in submitting to the Society for its approval the Tentative Specifications for Stainless Steel Wire Strand. The committee is proceeding with its plans for a full-scale program of atmospheric exposure tests that has been under consideration for several years and it is hoped that specimens can be exposed before the end of 1953. For purposes of comparison, a number of specimens of straight chromium and chromium-nickel stainless steel sheets as used in architectural applications have been exposed. A newly developed electrolytic oxalic acid etching technique as a means for screening stainless steels from the boiling nitric acid test (A-262) is under consideration. The final draft of the proposed recommended practice for the cleaning and passivation of stainless steel equipment is nearing completion. Consideration is being given to the inclusion of the boiling acid copper sulfate test as a requirement in stainless steel standards.

The activities of the Subcommittee on Metallography are currently devoted to the preparation of a report on metallographic techniques for identification of sigma phase in austenitic chromium-nickel stainless steels. This report will be published as an appendix to the A-10 report as it will appear in the 1953 *Proceedings*. A special task group is preparing a report on the mechanical properties of extra-low-carbon grades 304L and 316L. A task group of the Subcommittee on Super-Strength Alloys, which was formed last year, has completed a list of all available superstrength alloys. This list will be used as a basis for the preparation of tentative specifications. A second task group is preparing a compilation of the existing aeronautical materials specifications for similar alloys.

### **B-1 on Wires for Electrical Conductors**

For many years there has been need for industry standardization on stiffness requirements for soft copper wire, particularly as applied to magnet wire, as evidenced by the development of many special test methods by individual users (Morehouse, RCA, Belden, LSE, Rockwell Superficial, etc.). Committee B-1 has considered this problem over the years but has been unable to establish one method as being applicable for all requirements. Therefore, in order to provide a start in this direction, it limited present consideration to bare soft square and rectangular copper wire. The result has been the publication of the Tentative Method of Test for Stiffness of Bare Soft Square and Rectangular Copper Wire for Magnet Wire Fabrication. This method covers the low-stress elongation (LSE) test.

The Tentative Specifications for Soft or Annealed Copper Wire (B-3) have been

revised to include statistical sampling procedures, as was done in 1951 with the Tentative Specifications for Hard-Drawn Copper Wire (B-1).

### **B-2 on Non-Ferrous Metals and Alloys**

Still under debate within the committee is the question of whether there should be a specification for pig tin. As a preliminary to these discussions a Symposium on Tin was held at the 1952 Annual Meeting and is being issued as a separate publication, *ASTM STP No. 141*. The variance of opinion among the members with respect to such specifications has resulted in the formation of a task group to prepare a classification of the various grades of tin. A proposed tentative specification for rosin flux cored solder is being revised in the light of negative ballots received. Revisions of the nickel specifications are currently under consideration as are three general requirement specifications for nickel: one for plate, sheet, and strip; one for rods and bars; and one for seamless pipe and tubing. Specifications for nickel-molybdenum (Hastelloy B) and nickel-chromium-molybdenum (Hastelloy C) are nearing completion. Supplementing the approved titanium standards, a task group is preparing a similar specification for sponge titanium.

### **B-3 on Corrosion of Non-Ferrous Metals and Alloys**

Results of acetic acid-salt spray tests indicate that this spray test is as effective, as the regular salt spray test for determining the quality of nickel-chromium or copper-nickel-chromium coatings on steel. Also, in the acetic acid-salt spray test, time to failure of zinc-coated steel is proportional to the thickness of zinc coating. Further tests will be made before revisions are made in Method B-117 (Salt Spray Test).

The program of calibrating the corrosivity of the atmosphere at each of the several ASTM test sites by exposing specimens of zinc and steel continues, and an interim report on these tests was presented at the Annual Meeting and will be appended to the Committee B-3 report. The first group of disk-type magnesium couples have been removed and are currently being tested. The exposure of the spool-type samples (Part 2) of the magnesium galvanic couple program has been completed and results are now being evaluated. Part 3, which consists of plate-type couples has been delayed, and it may be another year before these specimens are ready for exposure.

### **B-5 on Copper and Copper Alloys**

For several years Committee B-5 has been working on specifications for refrigeration service copper tube. The Tentative Specifications for Seamless Copper Tube for Refrigeration Service approved for publication at the 1953 Annual Meeting cover this product in coils intended for use in the field for connection, repairs, and alterations. Copper with a high residual phosphorus

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content will be normally used, although provision is made for using copper with low residual phosphorus or oxygen-free copper without residual deoxidants.

### B-6 on Die-Cast Metals and Alloys

Attention should be called to the fact that the revision of Specification B 86 (zinc-base die castings) recommended by Committee B-6 was defeated on the floor of the annual meeting and this revision was therewith withdrawn from the report of the committee. The by-laws of the committee have been revised so that any member who fails to attend a subcommittee meeting for three consecutive meetings will be automatically dropped. Subject to letter ballot approval, the appendix (tension and impact values) to Specifications B 85 (aluminum-base die castings) will be removed and replaced with a suitable note stating that the data will be replaced with more up-to-date values as soon as they have been determined. Consideration is being given to the addition of Alloy SC114A to this group of alloys. This is similar to Alloy SC84A except the silicon limits are 10.5 to 12.0 per cent. Allowable limits are being determined for "tramp" elements in zinc-base die-casting alloys. New series of exposure tests on aluminum alloy SC84 have been exposed at the 80-ft and 800-ft sites at Kure Beach, N. C., New York City, and Columbus, Ohio, for 1-, 3-, 6-, and 12-yr periods.

Subcommittee VII on Magnesium-Base Alloys is making an effort to supplement the data in the appendix to Specification B 94 (magnesium-base die-casting alloys) with pertinent information over and above the tensile, elongation, and impact values now shown. A task group has been appointed to study the effect of iron content in the copper-base alloy ZS331A in the range from 0.10 to 0.50 per cent.

A paper entitled "An Analytical Study of the Die-Casting Processes" by Bruno Sachs was recommended for publication and will appear in the September ASTM BULLETIN.

### B-7 on Light Metals and Alloys, Cast and Wrought

New standards are being prepared by Committee B-7 which include specifications for other forms of bus conductors than those in Specifications B 236 and specifications for aluminum alloy standard structural shapes. The committee in cooperation with the American Foundrymen's Society is preparing a tabulation of the properties and characteristics of magnesium casting alloys. Statistical sampling methods as applied to testing for mechanical properties are currently under investigation. The name and scope of Subcommittee VI has been broadened to include anodic oxidation of magnesium as well as aluminum alloys. Further work on codification of temper designations is in progress.

The details of the test program and early results of the exposure program of 27 aluminum alloys and 8 magnesium alloys

were described in a paper by L. H. Adam. Exposures have been made at New York City, State College, Pa., Kure Beach, N. C., and Point Reyes, Calif. Exposures will also be made at Freeport, Tex., as soon as facilities are available. This report will be appended to the report of Committee B-7.

### C-1 on Cement

Another field of cement production has been entered by Committee C-1 on Cement as a result of studies by a new Subcommittee on Properties of Slag Cement. A proposed specification for slag cement was accepted for circulation to the entire committee for comments, preparatory to recommendations for acceptance at the Fall Meeting. The committee recommended to the Society a new tentative method for mechanical mixing of hydraulic-cement mortar after extensive studies in comparing with hand mixing. A 25-yr progress report covering the work of the Cement Reference Laboratory has been prepared, which indicates the volume of coverage by this service throughout the United States and Canada. The present tour of inspection has included between 40 and 50 laboratories in the Northwest of the United States and Western Canada. Subcommittee activity on chemical analysis includes a promising method for the direct determination of alumina content in cement. A rapid method for measuring the heat of hydration is now in final form and will be distributed to the committee for comment. It was reported that the use of mechanical mixing in place of hand mixing will not appreciably affect strength test results or entrained air in cement mortars. The trend toward performance standards on cement was noted by the fact that Standard Specification C 150 now includes a performance standard for the determination of SO<sub>3</sub> rather than the use of chemical analysis.

The committee is planning to hold its Fall Meeting at Purdue University on October 19-21, as a combined meeting with Committee C-9 on Concrete and Concrete Aggregates.

### C-4 on Clay Pipe

A proposed specification for clay flue linings was accepted at the meeting of Committee C-4 on Clay Pipe. This action represents the first attempt to standardize in this difficult field, wherein there is much variety in shapes and sizes throughout the country. A subcommittee spent considerable time in preliminary study and conducted a national survey to obtain data on existing conditions. Previous to the Annual Meeting, the Society accepted a new tentative in which all methods of tests for clay pipe were incorporated which were formerly included in the several specifications for clay pipe.

### C-7 on Lime

Recognizing the increased use of lime in soil stabilization work, Committee C-7 on Lime accepted a proposed tentative specification for lime for this purpose, which will be circulated to the committee for letter ballot. The request for this specification originated in Committee D-4 on Road and Paving Materials.

### C-9 on Concrete and Concrete Aggregates

After several years of study, including the writing of 13 drafts, the Subcommittee on Lightweight Aggregates presented two proposed tentative specifications to Committee C-9 on Concrete and Concrete Aggregates, which will first be circulated to the committee preliminary to a request for letter ballot. These two proposed specifications represent significant revisions in the existing ASTM Specification C 130. The two new specifications cover (1) lightweight aggregates intended for use in structural concrete, in which prime considerations are lightness in weight and compressive strength of the concrete and (2) lightweight aggregates intended for use in concrete masonry units in which a prime consideration is lightness in weight. The much discussed proposed specification on fly ash has been further reviewed by a special task group, which has agreed on a proper limit for ignition loss. The proposed specification will now be re-



Some of Committee B-7 at the Annual Meeting. At the table, I. V. Williams, Chairman, Ray Smith, Secretary, A. A. Moore, P. V. Faragher. Standing, Don Colwell, and John Millson.

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written as only one general specification using alternate clauses for special needs. It is expected that committee action will be requested at the Fall meeting. A method of test for fly ash as an admixture to portland cement concrete was presented to the Society for acceptance as a new tentative. Significant changes were approved in the Standard Specifications for Ready-Mixed Concrete (C 94), and recommendations are planned for the next meeting of Committee C-9. Continuing the recently inaugurated plan of presentation of papers at a committee meeting, four informal reports were presented. "The Distinction of Limestone and Dolomite" was discussed by D. O. Woolf, Bureau of Public Roads, representing his Subcommittee on Aggregate Mineralogical Characteristics. E. L. Spencer, Northeastern University, described "An Undergraduate Cement and Concrete Testing Laboratory Course." A report on the "Inspection of Concrete Compression Test Procedures," by J. R. Dwyer, National Bureau of Standards, reflected the work being done by the Cement Reference Laboratory. The "Behavior of Elastic Waves in Concrete," presented by J. R. Leslie, represented the scope of work in the Subcommittee on Dynamic Testing. Committee C-9 will meet with Committee C-1 on Cement during the week of October 19-23 at Purdue University.

### C-11 on Gypsum

Committee C-11 on Gypsum accepted two proposed specifications for letter ballot. A specification for gypsum form-board is for use in connection with poured-in-place reinforced gypsum concrete roof decks. The second proposed specification is for gypsum concrete, which will cover mill-mixed material, consisting essentially of calcined gypsum and suitable aggregate, and is intended for use in the construction of poured-in-place roof decks or slabs. Two types of gypsum concrete are included, namely, calcined gypsum and wood chips or shavings, and calcined gypsum and perlite or vermiculite. A complete revision of Standard Specification for Sand for Plaster (C 35) was accepted by the Society during the year representing modifications which recognize the newer lightweight aggregates now being used. Changes were agreed upon at the meeting in the gradation requirements of perlite and for sand in the recently adopted "Tentative Specifications for Inorganic Aggregates for Use in Interior Plaster (C 35 T)." After considerable study, the committee has now accepted the alcohol wash method for determination of fineness in the Standard Methods of Testing Gypsum and Gypsum Products (C 26).

### C-12 on Mortars for Unit Masonry

Significant revisions of the Tentative Specifications for Mortar for Unit Masonry (C 270 T) were agreed upon by Committee C-12. Revisions will now permit the use of



Section II on Rusting of Committee D-2's Technical Committee C. Left to right: Wilfred Pohl, A. R. Black, C. L. Pope, Henry Lewis, Walter Jackson, R. J. Ronan, and Chairman F. B. Lovell.

a mortar which does not meet the proportion requirements but will meet the property requirements if data are submitted confirming its acceptability. A straight lime mortar is now permitted if it meets the property requirements. In order to avoid misinterpretation of designations of the several types of mortar, new symbols have been recommended, including type C for an all-cement mortar, type L for an all-lime mortar, and L-C for a lime-cement mortar.

The scope of the committee will be reviewed in conjunction with the need for work on pozzolans in connection with lime.

### C-15 on Manufactured Masonry Units

The need for ASTM standards in the field of waterproofing materials for masonry has been discussed for a considerable period and received specific attention in the meetings of Committee C-15 on Manufactured Masonry Units. It was decided that a new subcommittee be formed to make a study of the problems involved in establishing standards, which will include both the masonry unit and the masonry wall. Considerable progress was also reported on another new activity of the committee, namely, standards to cover types of units now considered in a brick-block category. A proposed specification has been prepared for committee circulation to cover units which are in the category of 35 to 40 per cent cored space units.

### C-20 on Acoustical Materials

A development of considerable interest and representing the first proposed standard from Committee C-20 on Acoustical Materials was presented at the committee meeting for purposes of comment. This proposed method provides for approximate measurements of acoustical performance by measuring impedance and absorption of acoustical materials by a device known as the acoustical impedance tube. This method furnishes a means for measuring small samples of a given material as compared with the reverberation room procedure on large samples. Two proposed test methods are approaching final form, which apply to the maintenance of acoustical materials. One method will measure the paintability and the other the workability factors of maintenance ma-

terials. The need for a specification for acoustical adhesives, as well as test methods, has been reflected in concerted activity on the part of a task group in the Subcommittee on Application, which has now prepared drafts which will be submitted to letter ballot of the subcommittee.

### D-1 on Paint, Varnish, Lacquer, and Related Products

Committee D-1 presented to the Society as tentative the first set of purchase specifications for high-gravity glycerin used in the manufacture of alkyd and other synthetic resins together with methods of sampling and testing glycerin. Two important methods for determining optical properties were also submitted. These covered a revised method of Test for Specular Gloss (D 523), also a new Tentative method for Calculating Small Color Differences from Data Obtained on the Hunter Multipurpose Reflectometer. Presented also were revised Specifications for Magnesium Silicate Pigment (D 605 - 53) covering pigments that consist substantially of natural hydrous magnesium silicate in fibrous, platy, or granular forms. These specifications are restricted to those magnesium silicate minerals which can be suitably processed to what is commercially known as paint pigment quality.

Appended to the report for information only was a Proposed Method of Test for Viscosity Reduction Power of Hydrocarbon Solvents, and also a Revised Proposed Method of Test for Flash Point of Volatile Flammable Materials by Tag Open-Cup Apparatus.

The committee and its 56 subcommittees and working groups held meetings over a three day period, featured by an interesting talk on the "Technical Responsibility to Management in the Paint, Varnish and Lacquer Industry" by C. H. Reed, Forbes Varnish Co., Cleveland, Ohio. The interest in Mr. Reed's talk was evidenced by the large attendance of about 250 members of the committee.

### D-2 on Petroleum Products and Lubricants

Committee D-2 had the distinction of presenting to the Society some 66 recommendations affecting standards, the largest number submitted by any committee.

The D-2 Report was also the largest one preprinted, totaling 128 pages. The 91 meetings of Committee D-2 and its various divisions and subcommittees held over the entire six days of the Annual Meeting was also the largest number of meetings of a single committee. The "ASTM Viscosity Tables for Kinematic Viscosity Conversions and Viscosity Index Calculations" became available during the D-2 meetings. This collection of tables replaces the former ASTM Conversion Tables for Kinematic and Saybolt Universal Viscosities, published since 1939. The new tables are based on the new value of 1.0038 centistokes at 68 F as the standard value for the kinematic viscosity of water adopted by the National Bureau of Standards as of July 1, 1953.

During the meeting it was also announced that the National Bureau of Standards had decided to defer until Jan. 1, 1954, the discontinuation of Circular C410 "National Standard Petroleum Oil Tables" and its supplement. The withdrawal of Circular C410 was originally scheduled for July 1, 1953, but was postponed in order to allow time for the republication of the tariffs of pipe-line companies and the necessary changes in other legal and regulatory documents which make special reference to Circular C410. The data and information in Circular C410 have now been incorporated in the ASTM-IP Petroleum Measurement Tables (ASTM Designation D 1250; IP Designation 200) prepared jointly by the ASTM and the Institute of Petroleum (London). Table 5 which covers reduction of observed API gravity to API gravity at 60 F, and Table 7 on Reduction of volume to 60 F against API gravity at 60 F are now available as separate reprints from ASTM Headquarters. Steps are being taken for the separate publication of all individual tables.

An important addition to the D-2 report was a proposed revision of the Tentative Specifications for Aviation Gasoline (D 910) to provide for an additional grade 108-135.

It was also announced that the Subcommittee on Graphite was recommending for publication as information a proposed method for chemical analysis of graphite.

Final agreement was reached at the meeting on the reference standards for the Copper Strip Corrosion Test in Method D 130. A method for reproducing copper corrosion standards has now been perfected. This revision of Method D 130 will be submitted to final letter ballot vote of Committee D-2 during the Summer and presented to the Society through the Administrative Committee on Standards. Further announcement regarding the availability of the ASTM copper corrosion standards will be made available at that time.

### **D-4 on Road and Paving Materials**

New developments and techniques reported at the meeting of Committee D-4 on Road and Paving Materials dealt with structural properties, mineral aggregates, and their effect upon bituminous mixtures.

The determination and measurement of particle shape of both fine and coarse aggregate can be determined by the use of a cone method for fine aggregate and the evaluation of particle shape of coarse aggregate by the use of slotted screens or sieves. The use of the flame photometry apparatus is now being applied to the study of stripping action by comparison of particles coated with sodium chloride with particles coated with bituminous materials. The application of radioactive tracer techniques to the measurement of the degree of stripping of asphalt is also under consideration.

The acceptance of new Tentative Specifications for Materials for Soil-Aggregate Subbase, Base, and Surface Courses (D 1241T) recognized a development, in conjunction with Committee D-18 and the AASHO, which place these requirements on a more logical and systematic basis.

The committee will hold a one to two-day meeting of the Advisory Subcommittee in Washington during the week of September 6, and the entire committee will plan to meet during the 1954 group meeting, also in Washington. At this time, the committee will plan an appropriate observance of its 50th Anniversary as an ASTM technical committee.

### **D-5 on Coal and Coke**

Committee D-5 at its meeting furthered its plans for the Symposium on Statistical Aspects of Coal Sampling which is planned for the 1954 Annual Meeting of the Society. Committee D-5 has been taking an active part in the work of Technical Committee 27 on Solid Mineral Fuels, of the International Organization for Standardization. To continue this active cooperation it was agreed that it would be necessary for several U. S. delegates to attend the ISO meeting, also that cooperative laboratory studies would need to be carried on to investigate projects under consideration. To carry on such an active program the Advisory Committee of Committee D-5 decided it would be necessary to raise a fund in order to finance the necessary cooperative work.

### **D-6 on Paper and Paper Products**

Committee D-6 on Paper and Paper Products recommended to the Society a new Tentative Method of Test for Dimensional Changes of Paper with Changes in Moisture Conditions. The committee has completed a reorganization plan which will more equitably distribute the activities of the committee. The committee will now be composed of subcommittees covering the following: Sampling; Chemical Properties; Physical Testing of Paper; Physical Testing of Paperboard; Specifications for Paper; and Editorial. The next meeting of the committee will be held on February 18 and 19 in New York City at the time of the meeting of the

Technical Association of the Pulp and Paper Industry.

### **D-8 on Bituminous Waterproofing and Roofing Materials**

A means of determining in advance the service life of bituminous waterproofing and roofing materials has long been a principal subject for consideration by Committee D-8 on Bituminous Waterproofing and Roofing Materials. A new method of test is now being developed which will attempt to show whether bituminous waterproofing and roofing materials will crack under conditions of stress, strain, temperature, and time that are encountered in service.

### **D-9 on Electrical Insulating Materials**

The Committee announced that work has been completed on an extensive revision of the Tentative Methods of Test for Power Factor and Dielectric Constant of Electrical Insulating Materials (D 150 - 47 T). The revised method which has been under active study for the past three or four years will bring up to date the apparatus and various techniques for these tests. The revised methods cover procedures for the determination of capacitance, dielectric constant, dissipation factor, loss factor, power factor, phase angle, and loss angle when the standards used are lumped impedances. The frequency range that can be covered extends from a few cycles to several hundred megacycles.

The committee had a very interesting and productive series of meetings on June 29-July 1 with sessions of 14 subcommittees and sections.

### **D-16 on Industrial Aromatic Hydrocarbons and Related Materials**

The main Committee and its subcommittees held meetings on June 29 and 30. Certain of the subcommittees are developing test programs under the enlarged scope of the committee. The following test methods for refined naphthalene are now under cooperative investigation: Tests for Solidifying Point, Wash Tests, Color, Ash, and Nonvolatile Matter. For testing crude naphthalene the following procedures are being investigated: Solidifying Point, Evaporation Residue, Benzene and Soluble Matter, and Moisture.

The Subcommittee on Phenolic Compounds has undertaken a study of tests for moisture and melting point or freezing point of phenol.

The Subcommittee on Monocyclic Aromatics has indicated that it favors the restriction of the acid wash test (D 848) to aromatic hydrocarbons to avoid the misuse of it on petroleum fractions. It is also studying the best use of Bromine Number and determining through cooperative tests where present specifications for benzene, toluene, and xylene should be revised, particularly as to color and distillation.

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The Subcommittee on Nitrogen Heterocyclics is working on test methods for refined pyridine and refined quinoline. It is expected that relatively few properties will be needed to specify these two but that certain additional properties will be needed to cover special requirements of some users.

### D-17 on Naval Stores

The committee withdrew from its report the recommendations for publication of two new Tentative Specifications for Rosin and for Dipentene. Proposed drafts of these specifications were published as information in the 1952 Report of the committee and the current report as preprinted had proposed that these specifications be issued as tentative. However, further discussions in the committee indicated the desirability of withholding these recommendations pending further study of the desirability of having ASTM specifications for these naval stores products.

The committee recommended that the Tentative Method of Test for Unsaponifiable Matter in Rosin (D 1065 - 51 T) be continued as tentative pending study of a proposed alternate method published as information with its 1950 report. A program of active collaborative work on these methods has been laid out with the aim of having uniform procedures for determining unsaponifiable matter in both rosin and tall oil. The committee decided to reactivate its Subcommittee II on Crystallization of Rosin, in view of the appearance and use by industrial consumers of rosin of a number of new tests for determining whether a rosin has an abnormal tendency to crystallize after it has been converted into derived products for industrial use.

### D-18 on Soils for Engineering Purposes

A glossary of over 600 terms relating to soil mechanics was reviewed over a three-day period by a subcommittee of Committee D-18 on Soils for Engineering Purposes. This glossary is being developed in cooperation with the American Society for Civil Engineers. Three of the original and basic standard test methods on soils, dating back to 1939, have been reviewed with revisions now accepted for letter ballot. These standards include the Determination of Mechanical Analysis of Soils (D 422), Liquid Limit of Soils (D 423), and Plastic Limit and Plasticity Index of Soils (D 424).

A symposium is being planned for the 1954 Annual Meeting on the subject of permeability of soils.

### D-20 on Plastics

Committee D-20 on Plastics is giving consideration to the need for undertaking work on flexible coated fabrics. A study group has been appointed to review this subject.

There has been considerable interest evidenced in standards for plastic pipe

and a study group on this subject has been appointed.

Members of the committee participated in a general discussion of the low-temperature brittleness tests for plastics and elastomers at a meeting of one of the sections of Committee E-1 on Methods of Testing. Action was taken by Committee D-20 to submit to letter ballot of the committee revisions of the Tentative Method of Test for Brittleness Temperature of Plastics and Elastomers by Impact (D 746 - 52 T). Also submitted for letter ballot were some additional definitions and revisions in the Tentative Definition of Terms Relating to Plastics (D 883 - 52 T). Action is also being taken to revise the Standard Methods of Test for Index of Refraction of Transparent Organic Plastics (D 542 - 50).

It was announced that the extensive Specifications for Laminated Thermosetting Decorative Sheets have been approved by letter ballot of Committee D-20 and would be presented to the Society as tentative through the Administrative Committee on Standards during the Summer. A new Method of Test for Shrinkage of Molded and Laminated Thermosetting Plastics at Elevated Temperatures has also been similarly approved.

### D-22 on Methods of Atmospheric Sampling and Analysis

Twenty tentative definitions of the 75 terms originally listed as requiring definition have been developed by Committee D-22. Some 60 other suggested terms have been placed on a deferred list. A number of tentative standards are approaching the letter ballot stage. These include: general principles of sampling, sampling of gas and vapors, stack or collector effluent sampling, and miscellaneous sampling. A dilution method and a concentration method for determination of odor are currently out to letter ballot of the subcommittee. Work is progressing on determinations for fluoride, oxides of nitrogen, sulfur dioxide analysis, spot method for dirt, directional dust fall collection, and an oxidant recorder.

### E-4 on Metallography

Subcommittee XI on Electron Micro-

structure of Steel on Committee E-4 has published a report embodying techniques of electron metallography for studying aggregates of carbide and ferrite, such as pearlite, bainite, and tempered martensite. The work of the subcommittee as published in 1950 and 1952 has been directed toward gaining a fundamental knowledge of these structures in steel and, in the process of acquiring this information, to develop techniques of electron metallography that would preclude errors of interpretation resulting from faulty preparation of the specimen or from inadequate replication methods.

The results of the re-examination of techniques have been included in the 1953 Report. Work on replica techniques and various etching procedures on eutectoid carbon steel microstructures is covered.

### E-5 on Fire Tests of Materials and Construction

Committee E-5 on Fire Tests of Materials and Construction has inaugurated a program to secure funds from industry to continue investigational work at the U. S. Forest Products Laboratory, using a smaller size tunnel test equipment. This research is in connection with a need for a smaller scale test procedure based on the Tentative Method of Fire Hazard Classification of Building Materials (E 84 T). This work had been temporarily stopped by the lack of funds and changes in personnel connected with the work.

### E-7 on Non-Destructive Testing

The Bureau of Aeronautics has offered its set of Reference Radiographs for Inspection of Aluminum and Magnesium Castings to the Society for use as an *ASTM* standard. Committee E-7 has recommended that the set be published as the Tentative Reference Radiographs of Aluminum and Magnesium Castings.

### E-9 on Fatigue

In addition to the papers sponsored by the Committee each year, several special publications have been made available during the past year. *ASTM STP No. 121*, "Symposium on Statistical Aspects of Fatigue," was published as was *STP No. 137*, "Statistical Aspects of Fatigue-II." These two publications covered papers presented in 1951 and 1952, respectively. In addition, *ASTM STP*

### WHAT IS RESEARCH?

"'Research' is a high-hat word that scares a lot of people. It needn't. It is rather simple. Essentially, it is nothing but a state of mind—a friendly, welcoming attitude toward change. Going out to look for a change instead of waiting for it to come. Research, for practical men, is an effort to do things better and not to be caught asleep at the switch. The research state of mind can apply to anything: personal affairs or any kind of business, big or little. It is the problem-solving mind as contrasted with the let-well-enough-alone mind. It is the composer mind instead of the fiddler mind. It is the 'tomorrow' mind instead of the 'yesterday' mind."

—Charles Kettering

## Annual Meeting Report

No. 9C, "References on Fatigue," was made available last year and covered articles published in 1951. A similar publication, *ASTM STP No. 9D*, is now available and covers articles published in 1952.

Subcommittee IV (large machines) has been active in regard to the marine propeller shaft problem and a number of tests will probably be undertaken under the sponsorship of the American Bureau of Shipping and the American Society of Naval Architects. A task group is attempting to formulate statistical procedures which will be used for planning and interpreting fatigue investigations.

### E-12 on Appearance

Committee E-12 presented to the Society the first tentative method developed under its jurisdiction namely the Tentative Method of Test for 45-deg 0-deg Directional Reflectance by Filter Photometry. This method was prepared in cooperation with Committees C-22 on Porcelain Enamel, D-1 on Paint Materials, and D-6 on Paper. It represents a proposed consolidation of the two existing ASTM Methods D 771 and D 985, and a proposed method prepared by Committee C-22.

Committee E-12 made arrangements at its meeting to sponsor a Symposium on Color of Transparent Materials. This will be the third of a series of symposia sponsored by Committee E-12. The first, held in 1951, was devoted to appearance, its description, measurement, and specification. The second was a Symposium on Glass held in Detroit, Mich., in March, 1953. Dean Farnsworth, U. S. Naval

Submarine Base, was appointed as chairman of the Symposium Committee. It was announced that W. J. Kiernan, Bell Telephone Laboratories, had been appointed as chairman of Subcommittee II on Color and Spectral Characteristics to replace Dorothy Nickerson who had resigned so that she could devote more time to her new position as chairman of the Intersociety Color Council.

### ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals

The Low-Temperature Panel of the Joint Committee sponsored at the 56th Annual Meeting what proved to be one of the largest and most extensive symposiums held at a Society meeting, the five-session, 28-paper Symposium on Metallic Materials at Low Temperatures. This will appear in a somewhat condensed form as an ASTM publication which it is hoped will be available early next year.

Plans were made for another symposium at the 1954 Annual Meeting in Chicago on "The Effect of Cyclic Conditions of Heating and Stress on the Creep and Stress-Rupture Properties of Metals." This is a joint undertaking of the General Research and Gas Turbine Panels and will undoubtedly be at least two sessions in length. Under consideration is a proposed "Symposium on Basic Effects of Environment on Strength, Scaling, and Embrittlement of Metals at Elevated Temperature." No date has been set for the presentation of this symposium.

In accordance with the policy estab-

lished by the Data and Publications Panel to issue data on selected groups of alloys and metals rather than to attempt an over-all compilation of data as was done in the 1939 "Creep Data" volume, the first report, "Strength of Wrought Steels at Elevated Temperatures," *ASTM STP No. 100*, was issued in 1950. This was followed by a "Report on the Elevated Temperature Properties of Stainless Steels," *ASTM STP No. 124*, in January, 1952. The "Report on the Elevated Temperature Properties of Chromium-Molybdenum Steels" is currently in preparation and copies should be available from Headquarters early in the Fall. Other surveys in progress include data on superalloys which may be published before the next meeting. Following this publication will be special technical publications on "relaxation data," "strength of weldments at elevated temperatures," and "copper-base alloys." Consideration is also being given to making such data available for aluminum alloys. These Special Technical Publications, each dealing with a group of similar alloys, have supplied industry with a single source of a large amount of data which have been previously available only with recourse to numerous manuals and tables and the acceptance of these *STP's* has been widespread.

The Joint Committee accepted with regret the resignation of N. L. Mochel as chairman of the Steam Power Panel. The chairmanship of this group has been taken over by P. M. Brister.

## List of New and Revised Tentatives with Serial Designations

THE Society accepted at the Annual Meeting 63 new tentatives and revisions in 98 former tentative specifications and methods of test. Of the revised tentative specifications and methods ten have been extensively revised and the titles are given below (marked with an asterisk) with the list of those issued by the Society for the first time. In addition, five standards have been revised and reverted to tentative status. Designations of technical committees responsible for the various items are indicated after the boldface materials headings.

### Steel (A-1)

#### Specifications for:

Cold-Rolled Carbon Steel Deep-Drawing Sheet, Special Killed for Miscellaneous Drawn or Severely Formed Parts (A 365 - 53 T).

Cold-Rolled Carbon Steel Sheet, Commercial Quality (A 366 - 53 T).

#### Methods and Definitions for:

Mechanical Testing of Steel Products (A 370 - 53 T).

### Cast Iron (A-3)

#### Method of:

Chill Testing of Cast Iron (A 367 - 53 T).

### Iron-Chromium, Iron-Chromium-Nickel, and Related Alloys (A-10)

#### Specification for:

Stainless Steel Wire Strand (A 368 - 53 T).

### Wire for Electrical Conductors (B-1)

#### Method of:

Test for Stiffness of Bare Soft Square and Rectangular Copper Wire for Magnet Wire Fabrication (B 279 - 53 T).

#### Specifications for:

\*Soft or Annealed Copper Wire (B 3 - 53 T).

### Copper and Copper Alloys, Cast and Wrought (B-5)

#### Specifications for:

Seamless Copper Tube for Refrigeration Service (B 280 - 53 T).

### Electrodeposited Metallic Coatings (B-8)

#### Recommended Practice for:

Preparation of Copper and Copper-Base Alloys for Electroplating (B 281 - 53 T).

### Metal Powders and Metal Powder Product (B-9)

#### Specifications for:

Sintered Metal Powder Structural Parts from Brass (B 282 - 53 T).

### Cement (C-1)

#### Method of:

Mechanical Mixing of Hydraulic-Cement Mortars of Plastic Consistency (C 305 - 53 T).

\*Test for Air Content of Hydraulic Cement Mortar (C 185 - 53 T).

### Chemical-Resistant Mortars (C-3)

#### Methods of:

Test for Compressive Strength of Resin-Type Chemical-Resistant Mortars (C 306 - 53 T).

Test for Tensile Strength of Resin-Type Chemical-Resistant Mortars (C 307 - 53 T).

## **Annual Meeting Report**

Test for Working and Setting Times of Resin-Type Chemical-Resistant Mortars (C 308 - 53 T).

### **Concrete and Concrete Aggregates (C-9)**

#### *Specifications for:*

Liquid Membrane-Forming Compounds for Curing Concrete (C 309 - 53 T).  
\*Bleeding of Concrete (C 232 - 53 T).

#### *Methods of:*

Test for Resistance of Concrete Specimens to Slow Freezing in Air and Thawing in Water (C 310 - 53 T).  
Test for Fly Ash as an Admixture for Portland Cement Concrete (C 311 - 53 T).

### **Thermal Insulating Materials (C-16)**

#### *Recommended Practice for:*

Clearance of Preformed Thermal Pipe Insulation (C 312 - 53 T).

### **Asbestos-Cement Products (C-17)**

#### *Specifications and Methods of Test for:*

\*Flat Asbestos-Cement Sheets (C 220 - 53 T).

### **Porcelain Enamel (C-22)**

#### *Methods of:*

Test for Adherence of Porcelain Enamel and Ceramic Coatings to Sheet Metal (C 313 - 53 T).

Test for Warpage of Porcelain Enamelled Flatware (C 314 - 53 T).

### **Paint, Varnish, Lacquer, and Related Products (D-1)**

#### *Specifications for:*

High-Gravity Glycerine (D 1257 - 53 T).

#### *Methods of:*

Sampling and Testing High-Gravity Glycerine (D 1258 - 53 T).

Test for Nonvolatile Content of Resin Solutions (D 1259 - 53 T).

Test for Calculating Small Color Differences on the Hunter Multipurpose Reflectometer (D 1260 - 53 T).

### **Petroleum Products and Lubricants (D-2)**

#### *Methods of:*

Test for Effect of Grease on Copper (D 1261 - 53 T).

Test for Lead in New and Used Greases (D 1262 - 53 T).

Test for Leakage Tendencies of Automotive Wheel Bearing Grease (D 1263 - 53 T).

Test for Water Washout Characteristics of Lubricating Greases (D 1264 - 53 T).

Sampling Liquefied Petroleum Gas (D 1265 - 53 T). (Jointly with Committee D-3.)

Test for Sulfur in Petroleum Products and Liquefied Petroleum Gases by the  $\text{CO}_2\text{-O}_2$  Lamp Method (D 1266 - 53 T).

Test for Vapor Pressure of Liquefied Petroleum Gas (D 1267 - 53 T).

Test for Unsaturated Light Hydrocarbons (Silver-Mercuric Nitrate Absorption) (D 1268 - 53 T).

Test for Polarographic Determination of Tetraethyllead in Gasoline (D 1269 - 53 T).

#### *Method of:*

\*Calculation for Olefins and Aromatics in Gasoline (D 875 - 53 T).

\*Test for Kinematic Viscosity (D 445 - 53 T).

### **Gaseous Fuels (D-3)**

#### *Method of:*

Sampling Liquefied Petroleum Gases (D 1265 - 53 T). (Jointly with Committee D-2.)

### **Paper and Paper Products (D-6)**

#### *Method of:*

Test for Dimensional Changes of Paper with Changes in Moisture Conditions (D 1270 - 53 T).

### **Wood (D-7)**

#### *Specifications for:*

Copperized Chromated Zinc Chloride (D 1271 - 53 T).

Pentachlorophenol (D 1272 - 53 T).

#### *Methods of:*

Chemical Analysis of Copperized Chromated Zinc Chloride (D 1273 - 53 T).

Chemical Analysis of Pentachlorophenol (D 1274 - 53 T).

### **Electrical Insulating Materials (D-9)**

#### *Method of:*

Test for Corrosive Sulfur in Electrical Insulating Oils (D 1275 - 53 T).

#### *Specifications for:*

\*Flexible Treated Sleeving Used for Electrical Insulation (D 372 - 53 T).

### **Shipping Containers (D-10)**

#### *Method of:*

Test for Water Vapor Permeability of Shipping Containers by Cycle Method (D 1276 - 53 T).

### **Rubber and Rubber-Like Materials (D-11)**

#### *Specifications for:*

Non-Rigid Thermoplastic Compounds for Automotive and Aeronautical Applications (D 1277 - 53 T).

#### *Methods for:*

Determining Harmful Dirt in Crude Natural Rubber (D 1278 - 53 T).

### **Soaps and Other Detergents (D-12)**

#### *Method of Test for:*

Buffering Action of Metal Cleaners (D 1279 - 53 T).

Total Immersion Corrosion Test for Soak Tank Metal Cleaners (D 1280 - 53 T).

Rinsing Properties of Metal Cleaners (D 1281 - 53 T).

Analysis of Sodium Bicarbonate (D 501 - 53 T).

### **Textile Materials (D-13)**

#### *Methods of:*

Test for Average Fiber Diameter of Wool Tops by Porous Plug Tester (D 1282 - 53 T).

Test for Alkali-Solubility of Wool (D 1283 - 53 T).

Test for Relaxation and Felting Shrinkage in Laundering of Stabilized Knit Wool Fabrics (D 1284 - 53 T).

Testing and Tolerances for Yarn Containing Wool (D 1285 - 53 T).

\*Testing and Tolerances for Rayon Tire Cord (D 885 - 53 T).

### **Adhesives (D-14)**

#### *Method of:*

Test for Effect of Mold Contamination on Permanence of Adhesive Preparations and Adhesive Bonds (D 1286 - 53 T).

### **Engine Antifreezes (D-15)**

#### *Method of:*

Test for pH of Concentrated Engine Antifreezes (D 1287 - 53 T).

### **Industrial Water (D-19)**

#### *Methods of Test for:*

Chemical Oxygen Demand (Dichromate Oxygen Demand) of Industrial Waste Water (D 1252 - 53 T).

Residual Chlorine in Industrial Water (D 1253 - 53 T).

Nitrite Ion in Industrial Water (D 1254 - 53 T).

Sulfides in Industrial Waste Water (D 1255 - 53 T).

#### *Scheme for:*

Analysis of Industrial Water (D 1256 - 53 T).

\*Hardness in Industrial Water (D 1126 - 53 T).

### **Plastics (D-20)**

#### *Specifications for:*

\*Vinyl Chloride Polymer and Copolymer Rigid Sheets (D 708 - 53 T).

### **Wax Polishes and Related Materials (D-21)**

#### *Method of Test for:*

Total Ash and Silica in Water-Emulsion Waxes (D 1288 - 53 T).

Nonvolatile Matter (Total Solids) in Water-Emulsion Waxes (D 1289 - 53 T).

Sediment in Water Emulsion Waxes by Means of Centrifuge (D 1290 - 53 T).

### **Methods of Testing (E-1)**

#### *Methods of:*

Test for Measuring Water Vapor Transmission of Materials in Sheet Form (E 96 - 53 T).

### **Non-Destructive Testing (E-7)**

#### *Reference Radiographs of:*

Aluminum and Magnesium Castings (E 97 - 53 T).

### **Appearance (E-12)**

#### *Method:*

Test 45-deg, 0-deg Directional Reflectance of Filter Photometry (E 98 - 53 T). (This method has been developed with Committees C-22, D-1, and D-6.)

### **Facts about the Big Book . . .**

THE enormous undertaking that is the triennial publication of the **ASTM Book of Standards** is revealed in a few Facts and figures:

Number of standards . . . . . 1892

Number of pages . . . . . 9975

Press time hr. . . . . 3962

Amount of type . . . . . 35 tons

Total number of books . . . . . 79,250

Amount of paper . . . . . 900 tons

(45 carloads)

Press pages . . . . . 100,533,975

# NEW ASTM PUBLICATIONS

## New Symposium Presents a Review and Prospect in Plastics Field

PUBLICATION of the Symposium on Plastics Testing—Present and Future (*STP 132*) brings together under one cover the group of papers presented at the 50th Anniversary Meeting of the Society in New York, N. Y., June, 1952.

The Symposium, developed by Committee D-20 on Plastics, had a dual purpose: to review from the ASTM viewpoint the progress made to date in plastics testing and the status of some of the accepted tests; and to attempt to indicate what direction future efforts at standardization will take if the results of recent contributions to theories of behavior of high polymers are given recognition in testing methods.

In accomplishing these aims the papers deal with the problem with respect to mechanical, thermal, optical, molding and permanence properties, conditioning and weathering of plastics, and a study of internal states of stress in cross-linked polymers.

Titles and authors of the papers are as follows:

• • •

## Index to Standards

THE Index to all seven parts of the 1952 Book of ASTM Standards has been mailed to all members and committee members of the Society. The purpose of this Index is twofold: (1) to reveal whether the Society has issued specifications, tests, or definitions on any particular material or subject and (2) show to where in the 9969 pages of the seven volumes the standards may be found.

To accomplish these purposes both a subject index and a list of standards in numeric order of their serial designations are provided.

The Index to Standards is distributed free of charge and is sent to groups of purchasing agents, Government technical personnel, and others interested in materials. Anyone interested can have his name added to the mailing list to receive the Index as issued each year.

*The Management and Significance of the Mechanical Strength Properties of Plastics* by C. H. Adams, Monsanto Chemical Co.

*Measurement of the Effect of Temperature on Some Physical Properties of Plastics* by J. P. Tordella, A. C. Webber, and E. B. Cooper, E. I. du Pont de Nemours & Co.

*Measurement of Color, Gloss, and Haze* by Harry K. Hammond, III, National Bureau of Standards, and George W. Ingle, Monsanto Chemical Co.

*The Effects of Molding Conditions upon the Permanence of Plastics* by J. L.

Williams and J. W. Mighton, The Dow Chemical Co.

*Residual Stresses in Phenolic Plastics* by L. E. Welch, Engineer, and H. M. Quackenbos, Jr., Bakelite Co.

The complete symposium including discussions and bibliographies relating to the individual papers can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia, Pa. Price to members is \$1.50; list price, \$2.00.

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## Bituminous Highway and Roofing Standards Compiled in Third Edition

THE third edition of the compilation, ASTM Standards on Bituminous Materials for Highway Construction, Waterproofing, and Roofing, is now available, revised and expanded to include 105 specifications, test methods, recommended practices, and definitions of terms.

Sponsored jointly by Committee D-4 on Road and Paving Materials, and Committee D-8 on Bituminous Waterproofing and Roofing Materials, the compilation also includes standards covering creosote materials which are under the jurisdiction of Committee D-7 on Wood but are directly related to the construction field.

Appendices in this publication include Proposed Methods of Test for Flash Point of Volatile Solvents by the Tag Open-Cup Apparatus; for Water in Petroleum and Bituminous Products; and Stripping Test for Bitumen-Aggregate Mixtures.

This compilation, bound in heavy paper cover, totals 368 pages. Copies priced at \$3.50 each (\$2.65 to ASTM members) can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

## Correction

IN THE Report on Standard Samples for Spectrochemical Analysis (1950) issued as *STP 58B*, it is stated on page 26 that pellet-form nickel of 99.99 per cent purity is available from the International Nickel Co., Research Laboratories, Bayonne, N. J. We have been advised by the supplier that this nickel is actually in the form of rod approximately 0.15 in. in diameter by 3 in. in length, and is distributed gratis in very limited quantities to qualified spectrographic laboratories.

## Technical Papers Published

IT IS planned to include in each issue of the *ASTM BULLETIN* a list of the technical papers which have recently appeared.

These lists largely comprise papers contained in the newer Special Technical Publications although some of them are advance printing of individual papers that are to appear in the *Proceedings*.

### Symposium on Exchange Phenomena in Soils

*Ion Exchange in Relation to Some Properties of Soil-Water Systems*—Ralph E. Grim

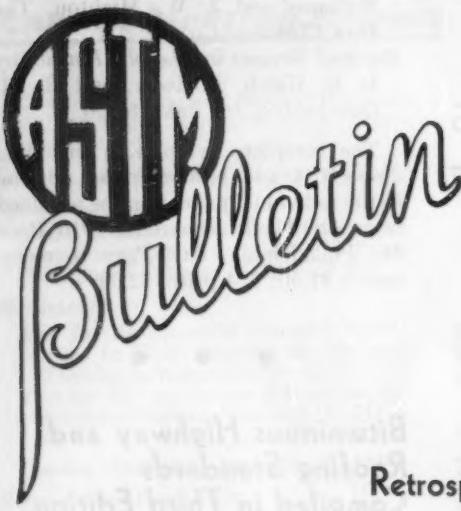
*Cation Exchange Capacity of Loess and Its Relation to Engineering Properties*—Donald T. Davidson and John B. Sheeler

*Job Experience with Exchange Phenomena Involving Inorganic and Organic Ions*—Hans F. Winterkorn

*Surface Chemical Properties of Clay Minerals and Soils from Theoretical and Experimental Developments in Electroosmosis*—Hans F. Winterkorn

*Some Effects of Treating Expansive Clays with Calcium Hydroxide*—Irving Goldberg and Alexander Klein

*Summary*—Edmund F. Preece



JULY 1953

NO. 191

NINETEEN-SIXTEEN  
RACE STREET  
PHILADELPHIA 3, PENNA.

## Retrospect

OUR Fifty-sixth Annual Meeting is over. It was a very successful one. Some 2500 of us are back at our desks and laboratory benches. Five hundred of our guest ladies have resumed their domestic chores.

Wistfully we recall earnest men with bulging brief-cases rushing purposefully to and from meetings; little groups discussing their technical problems in hotel corridors; formal lectures where the latest advances in science were presented; committee meetings where differences of opinion were reconciled; and pleasant social interludes.

More important, perhaps, are those bits of newly acquired technical information stored away in our subconscious that at some later date will assist in the solution of problems for the industries we represent.

Our Headquarters Staff and our gracious hosts, the Philadelphia District, breathed a sigh of relief. Running a meeting of this size is no mean task and they can take great satisfaction in a job well done.

Going home on the train I asked one of our British members what most

impressed him, since this was his first ASTM meeting. He said—"the friendly way in which suppliers and consumers and general interest members sit down together and arrive at mutually acceptable decisions and do it in such a short time." His wife said she had a wonderful time but she didn't see very much of her husband as he was so busy. I believe these truly objective statements might be summarized: we were busy and we got things done.

Now we are back home again and working hard to take care of the jobs that accumulated while we were away. When this is done we will then have some time to open those brief-cases of unfinished ASTM business and get ready for our next meeting . . . and so it goes . . . but we, and industry, and our economy have benefited by our work.

A handwritten signature in black ink, appearing to read "L.C. Beard, Jr." followed by a long, flowing cursive line.

President, ASTM

## Chicago Committee on Arrangements for 1954 Meeting

ONE of the first official duties of the new President, L. C. Beard, Jr., was to appoint Dr. A. Allan Bates, Vice-President of Research and Development, Portland Cement Assn., as Chairman of the General Committee on Arrangements for the 1954 Annual Meeting to be held in Chicago, June 14-18. These meetings will be at the Hotels Sherman and Morrison, with the exhibit and main headquarters at the Sherman.

Dr. Bates will have the support, as officers of the General Committee, of the three men now heading the Chicago

District Council, namely: J. E. Ott, General Manager, Consumers Products Div., Acme Steel Co., District Chairman; W. L. Bowler, The Pure Oil Co., District Vice-Chairman; and D. D. Rubek, Director, Chicago Research Div., Anderson-Pritchard Oil Corp., District Secretary.

Chairmen of the various subcommittees and personnel of these, as well as the general committee, now are being selected. Further announcements will be made. Considering the interest of our members in climatic conditions which may or may not prevail in Chi-

## JOHN K. RITTENHOUSE

(1877-1953)

It is with keen regret and a sense of deep loss that the Directors of the American Society for Testing Materials record the death, on March 13, 1953, of John K. Rittenhouse, ASTM Treasurer Emeritus, a loyal and devoted employee of the Society for 43 years.

A graduate of Peirce Business College, Philadelphia, Mr. Rittenhouse came with the Society on October 9, 1909, after some five years with the Steel and Wike Company (structural steel contractors), of which he had been secretary. He was the first full-time employee of the Society, and when he reported for work the Society's Headquarters were in the Civil Engineering Department of the University of Pennsylvania, Dr. Edgar Marburg, the head of that Department, being the first Secretary-Treasurer of the Society. In addition to accounting duties Mr. Rittenhouse assisted Dr. Marburg in administrative work. Following Dr. Marburg's death in 1918, and the appointment of the late Mr. C. L. Warwick as Secretary-Treasurer in 1919, Mr. Rittenhouse was elected Assistant Treasurer. However, his duties extended beyond this office, his responsibilities broadening with the growth of the Society, changes in Headquarters locations, and additions to personnel. For many years his additional activities included direction of various phases of the work—membership, publication sales, registration at annual meetings, and related projects. Conscientious, thorough, and diligent in all his work, he took great pride in it.

In 1946, when the office of Secretary-Treasurer was changed to that of Executive Secretary, Mr. Rittenhouse was elected Treasurer of the Society, a position which he filled with distinction. Following his retirement in April, 1952, he was honored at the Society's Fiftieth Anniversary Meeting in June, 1952, being accorded by the Board of Directors the title of Treasurer Emeritus, in recognition of his long-time service and intensive efforts in the Society's behalf.

Widely known in the Society, he had made a host of friends through the years. In closing this tribute, we acknowledge with sincere appreciation Mr. Rittenhouse's sustained interest and contributions through the changing years in furthering the welfare of the Society by assiduous application to his prescribed tasks; and extend sincere sympathy to Mrs. Rittenhouse and his family.

ago, it is comforting to know that all of the function rooms at both the Sherman and Morrison which will be used for registration, sessions, committee meetings, and exhibit, will be fully air conditioned. Also, many of the sleeping rooms have auxiliary air-conditioning equipment available at special charges. The lobbies and general space at both hotels are also air conditioned.

## Standards Committee Approves New Definitions of Adhesives Terms

THE Standards Committee on May 20, 1953, approved the recommendation brought by Committee D-14 on Adhesives to add tentative definitions of the terms "plasticity" and "primer" to ASTM Standard Definitions of Terms Relating to Adhesives (D 907 - 52 T). The definitions read as follows:

"*Plasticity*.—In the case of adhesives, a property which allows the material to be deformed continuously and permanently without rupture upon the yield value of the material."

"*Primer*.—In the case of adhesives, a coating applied to a surface, prior to the application of the adhesive, to improve the performance of the bond."

### September 1—Last Day for Annual Meeting Papers Discussion

WRITTEN discussion of papers and reports presented at the Annual Meeting will be received by the Committee on Papers and Publications until September 1. In view of the fact that much of the discussion published in the *Proceedings* is submitted after the meeting by letter, it will be helpful if all who can will send in their discussion to Headquarters well in advance of this date so that additional time is available to review and refer the discussion to authors for closure.

## The Society Appoints . . . .

W. J. KREFELD, Civil Engineering Research Laboratories, Columbia University, on ASA Construction Standards Board, succeeding J. W. Whittemore, Virginia Polytechnic Inst.

J. S. NELSON, Monsanto Chemical Co., to ASA Sectional Committee Z26 on Safety Glass, succeeding H. K. Nason, Monsanto Chemical Co.

C. A. BAKER, U.S. Testing Co. Inc., to ASA Sectional Committee on Hazards to Children.

K. G. COUTLEE, Bell Telephone Labs., Inc., to ASA Sectional Committee C 55 on Capacitors, succeeding E. O. Hausmann, Continental-Diamond Fibre Co.

W. G. HOLTZ, Bureau of Reclamation, has been appointed Society representative at International Soils Conference. G. P. Tschebotarioff who is attending the Conference will also represent ASTM.

## Schedule of ASTM Meetings

This gives the latest information available at ASTM Headquarters. Direct mail notices of all district and committee meetings customarily distributed by the officers of the respective groups should be the final source of information on dates and locations of meetings. This schedule does not attempt to list all meetings of smaller sections and subgroups.

DATE	GROUP	PLACE
Aug. 31	NACE Philadelphia Section Governing Board	ASTM Headquarters, Philadelphia, Pa.
Sept. 10	Committee D-23 on Cellulose and Cellulose Derivatives	Chicago, Ill.
Sept. 11	Committee E-13 on Absorption Spectroscopy	Chicago, Ill.
Sept. 11	Committee E-14 on Mass Spectrometry	Chicago, Ill.
Sept. 15-16	Committee C-13 on Concrete Pipe	Chicago, Ill.
Sept. 18	Joint ASTM-NACE Meeting	Franklin Institute, Philadelphia, Pa.
Sept. 25 to Oct. 2	Committee D-2 on Petroleum Products and Lubricants	Washington, D. C.
Sept. 28-30	Committee D-20 on Plastics	Atlantic City, N. J.
Sept. 30 to Oct. 2	Committee D-9 on Electrical Insulating Materials	Atlantic City, N. J.
Oct. 1-2	Committee B-1 on Wires for Electrical Conductors	ASTM Headquarters, Philadelphia, Pa.
Oct. 6-7	Committee B-5 on Copper and Copper Alloys	ASTM Headquarters, Philadelphia, Pa.
Oct. 8-9	Committee C-19 on Structural Sandwich Constructions	ASTM Headquarters, Philadelphia, Pa.
Oct. 7-9	Committee D-15 on Engine Antifreezes	Cincinnati, Ohio
Oct. 8	New England District Meeting	Cambridge, Mass.
Oct. 14-16	Committee D-13 on Textiles	New York City
Oct. 14-16	Committee D-14 on Adhesives	Wyandotte, Mich.
Oct. 19-21	Committee C-1 on Cement	Lafayette, Ind.
Oct. 21-23	Committee C-9 on Concrete and Concrete Aggregates	Lafayette, Ind.
Oct. 22-23	Committee D-10 on Shipping Containers	Boston, Mass.
Oct. 26-28	Committee C-16 on Thermal Insulating Materials	Williamsburg, Va.
Oct. 27	Pittsburgh District	Pittsburgh, Pa.
Oct. 27-28	Committee C-22 on Porcelain Enamel	Middletown, Ohio

## Council of Engineering Society Secretaries Meets

AT THE annual meeting of the Council of Engineering Society Secretaries in Atlantic City, June 5 and 6, ASTM Executive Secretary, Robert J. Painter, spoke on the "Aims, Purposes, and Methods of Operation of ASTM." This was in response to an invitation from the Council officers who indicated that a number of the members were interested in having a better picture of the Society's operations. During the course of his talk, Mr. Painter indicated the desire of the Society to cooperate fully in any matters involving research and standards in materials.

This Council includes the secretaries and staff members of many of the leading national and local engineering groups. For 1953, the following officers were elected:

*President*: Ernest Hartford, Executive Assistant Secretary, The American Society of Mechanical Engineers

*Vice-President*: E. H. Robie, Secretary,

American Institute of Mining and Metallurgical Engineers

*Secretary*: M. C. Turpin, Secretary, American Society of Refrigerating Engineers

*Treasurer*: Charles S. Doerr, Secretary, Engineers' Club of Philadelphia

*Directors*: T. J. Ess, Managing Director, Assn. Iron and Steel Engineers; J. Earl Harrington, Secretary, Western Society of Engineers; H. H. Henline, Secretary, American Institute of Electrical Engineers; O. L. Angevine, Executive Secretary, Rochester Engineering Society.

Of these officers, Messrs. Harrington and Henline carry over terms as Directors.

## Summary of Proceedings and Letter Ballot

The Summary of Proceedings of the Annual Meeting, setting forth the actions taken at the meeting will shortly be placed in the mails to all members in good standing. It will be accompanied by a Letter on all recommendations calling for formal adoption as standard. The ballot is to be canvassed September 15.

## DISTRICT ACTIVITIES

### New District Councilors

ASTM members and committee members have elected new councilors for their respective districts in accordance with the provisions of the ASTM Charter for Districts which has been in effect since 1947.

Terms of about one half the councilors of each district expire in June and officers' terms expire in the even number years. The names of all council members, the holdovers as well as those shown below, and the district council officers, will be in the 1953 Year Book now in preparation.

### New District Formed

During the past year a new district has been formed which includes Texas, Oklahoma, Louisiana, and that part of Arkansas not covered by the St. Louis District, and has been designated as the ASTM Southwest District. For this district, both officers and the entire membership of the council are shown. Members of the council serving one and two-year terms will be arbitrarily chosen by lot at a later date.

### Fall Meetings Scheduled

Several of the districts have already planned Fall meetings, including a joint NACE-ASTM meeting at Philadelphia on September 18, New England on Oct. 8, Pittsburgh on Oct. 27, and meetings in Houston, San Francisco, and Los Angeles in November. The speaker at the three latter meetings will be Dr. Frederick D. Rossini, the 1953 Marburg Lecturer.

Names of the new or re-elected Councilors who will hold office until June, 1955, are listed below. Please note that this is not a complete list of District Councilors but shows only those newly elected (marked with asterisk), newly appointed, or re-elected this year.

### Chicago

**Councilors:** J. H. Amrine, Imperial Molded Products Corp.; J. F. Calef, Automatic Electric Co.; T. J. Dolan, \* University of Illinois; F. A. Faville, Faville-LeVally Corp.; H. P. Hagedorn, City of Chicago, Purchasing Dept.; C. H. Jack-

man, United States Steel Corp.; A. M. Johnsen, The Pullman Co.

### Cleveland

**Councilors:** C. O. Burgess, † Gray Iron Founders' Society Inc.; H. F. Churchill, Case Institute of Technology; A. H. Du-Rose, The Harshaw Chemical Co.; W. C. Jenner, Reliance Electric and Engineering Co.; K. R. Knapp, American Gas Assn.; G. R. Rawson, American Steel & Wire Div., United States Steel Corp.; W. S. Scott, Republic Steel Corp.; R. B. Textor, The Textor Laboratories; J. J. Vreeland, Chase Brass & Copper Co.; J. C. Weaver, The Sherwin-Williams Co.; J. F. Weigel, Medusa Portland Cement Co.; A. E. Weiss, \* Superior Die Casting Co.

### Detroit

**Councilors:** D. M. Bigge, \* Chrysler Corp.; F. J. DeWitt, Parker Rust Proof Co.; Douglas Dow, Detroit Testing Lab.; Joseph Fink, \* City of Detroit, Dept. of Building & Safety Eng.; D. J. McKinnon, \* Detroit Steel Products Co.; O. W. McMullan, \* Bower Roller Bearing Co.; A. A. Moore, \* Dow Chemical Co.; E. L. Morrison, The Budd Co.; C. F. Nixon, \* General Motors Corp.; R. Sergeson, Rotary Electric Co.; C. E. Topping, Consumers Power Co.; H. Tuttle, \* Ford Motor Co.; H. L. Vanderwerp, \* Peerless Cement Corp.; A. D. Wagner, Hudson Motor Car Co.

### New England

**Councilors:** T. A. Berrigan, Mass. Sewerage Div., Metropolitan Dist. Comm.; W. D. Clement, University of New Hampshire; R. H. Doughty, Fitchburg Paper Co.; A. A. Klein, Norton Co.; F. W. Noevel, \* Goodall-Sanford, Inc.; D. C. Scott, Jr., Scott Testers, Inc.; A. L. Shields, Westinghouse Electric Corp.; W. C. Voss, Mass. Institute of Technology; H. J. Wollner, \* American Conditioning House, Inc.; R. W. Woodward, Underwood Corp.

### New York

**Councilors:** M. B. Chittick, American Mineral Spirits Co.; J. L. Christie, \* Handy & Harmon; C. W. Dorn, \* J. C. Penney Co., Inc.; H. M. Frecker, \* Jr., United States Rubber Co.; Benjamin Grodman, Dept. of Purchase, New York City; W. T. Gunn, \* American Petroleum Institute; P. S. Kingsley, General Electric Co.; W. J. Krefeld, Columbia University; L. S. Reid, \* Metropolitan Life Insurance Co.; S. Skowronski, International Smelting & Refining Co.; C. R. Stock, American Cyanamid Co.; T. Smith Taylor, United States Testing Co., Inc.; R. H. Titley,

<sup>†</sup> Appointed to fill unexpired term of vice-chairman.

Public Service Electric and Gas Co.; Sam Tour, \* Sam Tour and Co., Inc.; L. T. Work, Consulting Engineer.

### Northern California

**Councilors:** T. K. Cleveland, Philadelphia Quartz Co. of Calif.; R. N. Conner, Baldwin - Lima - Hamilton Corp.; R. E. Davis, University of California; C. H. Fitzwilson, Columbia-Geneva Steel Div.; J. J. Gould, Consulting Structural Engineer; G. J. Grieve, \* Pacific Paint & Varnish Co.; R. W. Harrington, \* Clay Brick & Tile Association; R. A. Kinzie, Santa Cruz Portland Cement Co.; W. N. Lindblad, Pacific Gas & Electric Co.; L. Mittelman, Tide Water Associated Oil Co.; W. W. Moore, Dames & Moore; G. H. Raitt, Consulting Engineer; R. C. Vollmar, Standard Oil Co. of Calif.; R. G. Wadsworth, \* City & County of San Francisco; H. A. Williams, Stanford University.

### Ohio Valley

**Councilors:** D. S. Bruce, The Gummed Products Co.; R. G. Chollar, National Cash Register Co.; F. M. Crapo, Indiana Steel & Wire Co.; B. W. Gonser, Battelle Memorial Institute; T. W. Guy, Consulting Engineer; Walter Klayer, Aluminum Industries; D. E. Krause, Gray Iron Research Institute; E. E. McSweeney, Battelle Memorial Institute; W. R. McIntosh, \* Civil Eng. Dept., University of Louisville.

### Philadelphia

**Councilors:** J. Bauer, \* Fred Whitaker Co.; W. C. Clements, Bethlehem Steel Co.; D. T. Harroun, \* Engineering Dept., University of Pennsylvania; A. H. Kidder, \* Philadelphia Electric Co.; S. S. Kurtz, Jr., Sun Oil Co.; L. P. Mains, Drexel Institute of Technology; W. J. McCoy, Lehigh Portland Cement Co.; J. J. Moran, Kimble Glass Co.; F. H. Pennell, \* DeLaval Steam Turbine Co.; P. Theel, Philadelphia Textile Institute.

### Pittsburgh

**Councilors:** F. H. Allison, Jr., Pittsburgh Rolls Div. of Blaw-Knox Co.; Hugh Beegly, Jones & Laughlin Steel Co.; A. R. Ellis, Pittsburgh Testing Laboratory; F. M. Howell, Aluminum Company of America; A. L. Johnson, Universal-Rundle Corp.; G. H. Knode, Pennsylvania Railroad Co.; Joseph Marin, \* Pennsylvania State College; P. G. McVetty, Westinghouse Electric Corp.; H. R. Redington, National Tube Div., U. S. Steel Corp.; F. N. Speller, Metallurgical Consultant; E. B. Story, A. M. Byers Co.; L. W. Vollmer, Gulf Research & Development Co.

### St. Louis

**Councilors:** J. E. Brock,\* Midwest Piping & Supply Co., Inc.; E. P. Buxton, Western Cartridge Co., Division of Olin Industries, Inc.; P. G. Herold, Missouri State Mining Experimental Station; E. W. Kleefisch,\* Nooter Co.; F. V. Reagel, Missouri State Highway Dept.; E. E. Scholer, Shell Oil Co., Inc.; A. C. Weber, Laclede Steel Co.; F. G. White, Granite City Steel Co.

### Southern California

**Councilors:** C. W. Beardsley, City of Los Angeles, Bureau of Standards; L. M. Boelter,\* Engineering Library, University of California; H. W. Bolin, California State Dept. of Public Works; Guy Corfield, Southern California Gas Co.; Bert Folda, General Petroleum Corp.; E. F. Green, Axelson Mfg. Co.; J. D. Herbert, Blue Diamond Corp.; C. E. P. Jeffreys, Truesdail Labs., Inc.; J. B. Morey, International Nickel Co., Inc.; R. E. Paine, Aluminum Co. of America; P. J. Rich,\* Kwikset Locks, Inc.; Leo Schapiro, Douglas Aircraft Co., Inc.; R. E. Vivian,\* School of Engineering, University of Southern California; D. Wilson, School of Engineering, University of Southern California.

### Southwest

**Chairman:** M. L. Holmberg,\* Metalurgical Consultant, Houston, Tex.  
**Vice-Chairmen:** R. C. Alden,\* Phillips Petroleum Co.; P. L. DeVerter,\* Humble Oil & Refining Co.; A. W. Eatman,\* Texas State Highway Dept.; Edwin Joyce,\* American Petroleum Institute.

**Secretary:** J. B. Baird,\* Southwestern Laboratories.

**Councilors:** J. H. Bateman,\* Louisiana State University; C. Baumberger, Jr.,\* San Antonio Portland Cement Co.; E. E. Berkley,\* Anderson, Clayton & Co.; R. R. Cahal,\* Southern Pine Inspection Bureau; A. B. Campbell,\* National Association of Corrosion Engrs.; K. P. Campbell\*, Sheffield Steel Corp.; C. M. Conrad,\* Southern Regional Research Laboratory; R. P. Daniels,\* Gulf Oil Corp.; R. F. Dawson,\* University of Texas; James Earthman,\* Wyatt Metal & Boiler Works; William G. Hall,\* Shell Chemical Corp.; Don Hart,\* Rainhart Co.; A. J. Hoiberg,\* Asphalt Technical Service & Dev.; S. E. J. Johnsen,\* Monsanto Chemical Co.; C. E. Lauer,\* The Texas Co.; C. F. Lewis,\* Cook Heat Treating Co.; William F. Lowe,\* Natural Gasoline Assn. of America; K. E. Luger,\* K. E. Luger Co.; B. R. Manuel,\* W. H. Curtin & Co.; H. L. McMullin\*, Texas & Pacific Railway Co.; M. A. Meyn,\* Pittsburgh Testing Laboratory; C. R. Neilon,\* The National Supply Co.; F. H. Newman, Jr.,\* Lockwood & Andrews, Engineers; F. P. Porter,\* Southwestern Laboratories; D. G. Reid,\* Chance Vought Aircraft; Joseph E. Russell,\* Texas Solvents and Chemicals; W. A. Schlueter,\* The Refinery Supply Co.; E. F. Schmidt,\* Lone Star Gas Co.; Herbert M. Shilstone, Jr.,\* Shilstone Testing Laboratory; Howard N. Simms,\* Black, Sivalls & Bryson, Inc.;

Harold M. Smith,\* Bureau of Mines; H. P. Smith,\* Texas A & M College; Thomas C. Tweedie,\* Houston, Tex.; H. D. Wilde,\* Humble Oil & Refining Co.; C. S. Wilson,\* Texas and New Orleans R.R. Co.; R. P. Witt,\* Oklahoma A & M College; Malcolm V. Reed,\* Dallas Tank Co., Inc.; O. R. Sherman,\* Pittsburgh Testing Laboratory.

### Washington, D. C.

**Councilors:** E. W. Bauman, National Slag Assn.; A. B. Cornthwaite,\* Virginia Dept. of Highways; H. F. Clemmer, Engineer Dept., District of Columbia; L. S. Crane, Southern Railway System; H. W. Easterly,\* Concrete Pipe and Products Co., Inc.; A. J. Kraemer,\* U. S. Bureau of Mines; C. E. Proudley,\* N. Carolina State Highway & Public Works Comm.; E. I. Williams,\* Riverton Lime and Stone Co.; J. E. Wood,\* Maryland State Roads Commission.

### Western New York-Ontario

**Councilors:** J. G. Augenstein, U. S. Rubber Reclaiming Co.; R. W. Cline,\* Buffalo Pottery Inc.; K. H. Ferber,\* National Aniline Div., Allied Chemical & Dye Corp.; G. S. Hallenbeck,\* Hallenbeck Inspection and Testing Laboratory; E. D. Jackson,\* Stokes Div., General Tire & Rubber Co. of Canada Ltd.; A. E. Klinger,\* Buffalo Steel Co.; W. H. Lutz, Pratt & Lambert, Inc.; G. S. Mallett, Anaconda American Brass, Ltd.; H. Thomasson,\* Canadian Westinghouse Co., Ltd.; G. H. von Fuchs, Consultant, Niagara Falls, N.Y.

## Kaleidoscope of Paints Topic of Southern California District Meeting

THE Southern California District meeting of June 5, held in Los Angeles' Rodger Young Auditorium, featured James W. Bowen, National Lead Co., as the speaker.

His subject, "Kaleidoscope of Paints," dealt with protective coatings in relation to the slogan "Save the Surface, and You Save All." Within the last decade enormous progress has been made in the development of new types of coatings, ranging from vinyl resins and chlorinated rubber to many types of acrylates and other plastics in various combinations. His talk, semitechnical in nature, covered past and present trends in the paint industry giving a number of examples of paint pigments and vehicles and was supplemented by the use of a 20-ft panel paint museum used as a visual aid.

Mr. Bowen, a graduate of University of Southern California, has been

active in the paint industry since 1924 and joined the Sales Department of the National Lead Co. in 1930. His present position is that of Sales Manager of the National Lead Co., Los Angeles Division.

The other feature of the evening was the excellent sound-color motion picture, prepared by the Corrosion Engineering Section of the International Nickel Co., Inc., entitled "Corrosion in Action."

## New York District and ASQC Hear Collier on Quality Control

SOME 70 members of ASTM and the American Society for Quality Control assembled to hear Simon Collier, Director of Quality Control, Johns-Manville Corp., discuss "Modern Quality Control" at the New York District meeting held at the Engineering Society's Building on April 16, 1953.

Mr. Collier is president of ASQC, a past director of ASTM, and since 1936 has served as chairman of ASTM Committee D-11 on Rubber and Rubber-Like Materials.

In his discussion Mr. Collier pointed out the necessity during the war years of using many substitutes. These substitutions tended toward a lowering in quality standards and as a result customers are now more critical and are demanding more quality than is really necessary. Johns-Manville has instituted an extensive training program designed to teach the more modern techniques of quality control to its production and inspection personnel. A part of Mr. Collier's presentation was a 40-minute sound color film outlining the basic principles of statistic quality control. This film is also a part of the company's training program.

Following Mr. Collier's talk, a panel discussion was held with Messrs. Collier, A. B. Mundell, Sonotone Corp., Enoch B. Ferrell, Bell Telephone Labs., and Ellis R. Ott, Rutgers University, participating. Some three-quarters of an hour of active discussion took place and was terminated only for the need of relinquishing the room at a set time. The excellence of the panel is evidenced from the fact that Mr. Collier is president of the ASQC, Mr. Ott is past-chairman of the Metropolitan Section, Mr. Mundell is the present chairman, and Mr. Ferrell is an incoming chairman of the Metropolitan Section.



## Washington District Holds First Meeting in Richmond

AT THE first meeting of the Society held in Richmond, Va., which was arranged by the Washington District, Dr. Allan A. Bates, Vice-President of Research and Development, Portland Cement Assn., spoke on "Engineering in the Post Defense Economy" and the Society's President, Harold L. Maxwell, discussed "Standards and Research," stressing their relationship, and indicating their importance in our economy. A résumé of Dr. Bates' remarks appears below.

There was an excellent attendance—about 75 being present for the social hour, dinner, and technical session, held at the Hotel Jefferson. Former District Chairman Harold F. Clemmer initiated plans for the meeting and with excellent collaboration at the Richmond end by Blake Cornthwaite, Testing Engineer, Virginia Dept. of Highways, and Grant Durant, President, Froehling & Robertson, Inc., a fine meeting resulted.

There were a goodly number of members from Washington and from scattered points of Virginia, Maryland, and North Carolina. The social hour was sponsored by the Southern Materials Co. Froehling & Robertson, the Portland Cement Assn., and Concrete Pipe and Products Co. all contributed in handling certain items in connection with the dinner. All of the district officers were present, namely Chairman E. F. Kelley, Chief, Physical Research Branch, Bureau of Public Roads; Vice-chairman Fred Burggraf, Director, Highway Research Board, National Research Council; and Secretary J. R. Dwyer, Research Associate, National Bureau of Standards. Executive Secretary R. J. Painter was introduced and spoke briefly. Mr. Kelley presided in his usual efficient manner.

The group at the first ASTM district meeting in Richmond, which was sponsored by the Washington District. Members will recognize some of those in the print. In the second row in the center spot is District Chairman E. F. Kelley whose black bow tie is a good starting point for identification of some of those in the picture. On his immediate left is Dr. Bates; then Fred Burggraf, District Vice-Chairman; Executive Secretary R. J. Painter; Past District Chairman H. F. Clemmer and Grant J. Durant, who aided greatly in the success of the meeting. On the chairman's immediate right is President H. L. Maxwell, then District Secretary John R. Dwyer and G. G. Sward. Blake Cornthwaite is behind the last bow tie visible in the third row left. Standing in the forefront of the extreme right is another long-time member, Shreve Clark. In front of Mr. Painter is E. W. Bauman and on his right is Carl Carpenter, Chairman of Committee D-4. A. T. Goldbeck, ASTM honorary member, is sixth from the right side of the last row.

## Bates Sees Construction Necessary to Stable Economy

IN his talk before the Washington District at Richmond, Va., A. Allan Bates, Vice-President of Portland Cement Assn., voiced his opinion that America's engineers are in the best position to realize the magnitude of planning required to maintain our economy at a properous level if and when defense spending drops off. Engineers, Mr. Bates said, should take the initiative within their professional societies, business organizations, and local communities, to develop the necessary plans to prevent a depression. Speaking of America's present economy, Mr. Bates pointed out that it is still tied in considerable measure to military production, which has been maintained at high level on the presumption that we have to defend ourselves in a war with Russia.

In support of the speculation that Russia may not start such a war, he cited the general feeling in Europe that Russia will go to considerable length to avoid war and will attempt to accomplish her ends by political and economic pressures in the hope of bleeding our economy to exhaustion.

If the 60 billion dollar yearly rate of defense expenditure is soon cut back to the 25 billion rate predicted by Senator Taft, the U. S. will have to find some way to spend 35 billion dollars on other goods and services to replace military procurement, and further, to find some

way to keep the economy expanding at about a 10 to 12 billion dollar a year rate, the estimated minimum average annual expansion required to keep it stable.

A number of answers have been given to the question of how this slack is to be taken up. *Construction* is Mr. Bates' answer. It would mean construction of a magnitude never before dreamed of in this country and would have to include vast works of slum clearance and city rebuilding, highways, airports and parking facilities, hospitals, schools, conservation, control of stream pollution, etc.

The immediate problems Mr. Bates envisions will be those of planning and financing which, in so far as possible should be done on a private and local level. To some extent public financing seems inevitable for several reasons, not the least of which is the fact that no administration dares face the prospect of another real depression and in order to avoid such an occurrence would resort to public works expenditures.

Looking ahead to these contingencies and planning to prevent economic dislocation and collapse, requires plans; and the very fact that such plans have been developed, Mr. Bates feels, will help materially to prevent depression psychosis which, according to the London *Economist*, is a basic ingredient of depressions.

## Applications of Abrasives

EDITOR'S NOTE.—The following is a combined abstract of talks on abrasives by Albert L. Ball, Director of Research, Bay State Abrasive Products Co., and A. A. Kline, Norton Co., before members and friends of the ASTM New England District at a meeting in Worcester, Mass., April 16, 1953.

THE ASTM'ers basic interest is in testing materials—a broad field of endeavor. The subject of abrasives is also broad. Evidence of the abrasive industry's growth is shown by the sales of bonded abrasives which in 1917 amounted to about \$17,500,000; in 1929, \$29,300,000; in 1943 (during the midst of World War II), about \$148,000,000; and in 1951, about \$168,000,000.

At present there are six companies making electric furnace abrasives in areas where hydroelectric power is relatively cheap. These areas include Niagara Falls, Tennessee Valley, and Bonneville Dam in the United States, as well as the Saguenay and St. Maurice Rivers in Quebec, Canada.

Abrasives are used in numerous ways—for example, to remove material, to remove a defect, to bring a piece to a dimension, and to establish a desired surface.

### History:

The first record of the use of abrasives dates back to the Paleolithic Age, approximately 15,000–25,000 B.C. At this time, man was engaged in fashioning and sharpening bone and horn to make implements of war and peace. Still in prehistoric time, he also formed and polished flint. As early as 4000 B.C., he had developed stone sawing, and at 1550–1100 B.C., he used abrasives for forming and sharpening iron. Proof of the latter was the discovery of a dagger and sandstone together in Egypt exploration.

The first written mention of emery was during the first century of the Christian era by Pliny the Elder, a Roman writer, encyclopedist, and naturalist. 1300 years later, the labor of small boys was replaced by using water power to turn grindstones.

In 1769, waterproof sandpaper was sold on the streets of Paris; the grit was held on with a varnish adhesive. What a "prior-public-use" wrench this might have thrown into our waterproof coated abrasive patent situation of the 20th century, if such a reference had been selected.

Lowthorp, in England in 1831, is credited with the first emery cloth. During the 19th century, industry used natural grindstones in grist mills, in paper mills for making pulp, and for edging tools. An important year in abrasive development is 1840 when

Dr. J. Lawrence Smith discovered emery deposits in Turkey, and at about 1864, American emery deposits were located at Chester, Mass., and Croton and Peekskill, N.Y. Other abrasives used toward the end of the century were corundum from Carolina and from Canada, as well as from India. The South African corundum deposits became industrially available in the 1920's. DePlanque patented rubber-bonded abrasives in 1857.

Our more modern abrasive era started in the 1890's and early 1900's with the making of silicon carbide and the fusion of aluminum oxide. Manufactured abrasives may be said to have started with the discovery of silicon carbide by Dr. Edward G. Acheson who produced this material by passing electricity through a mixture of clay and powdered coke. The discovery of fused alumina abrasives is attributed to Charles B. Jacobs, in the year 1897. The hardest abrasive manufactured by man, namely boron carbide, was first discovered by Henry Moissan, but became commercially available as late as 1934.

Shortly after the turn of the 20th century, there began a steady upturn in the use of grinding and lapping for finishing metals as greater and greater accuracy in dimensions became important. The situation was due to the development of the automobile, the airplane, railroad and farm equipment, as well as military materiel. It has been said, for instance, that a Ford automobile made by previous hand methods would cost about ten times its current price.

It took about 25,000 years—from Paleolithic man—to make these significant strides in abrasive invention. We have seen many developments in the ways of bonding abrasive grains, making all sorts of shapes, inventing newer kinds of hard materials and abrasives, and have seen the introduction of many new types of materials to grind. We are even today using ground-up diamond to cut slots in concrete roads.

### Abrasives and Their Preparation:

There are abrasive materials which occur in nature; others, of greater importance, are manufactured. Some of the natural abrasive materials are emery, corundum, garnet, flint, diamond, pumice, and sandstone. The

manufactured abrasives are silicon carbide, fused alumina, and boron carbide.

Abrasive materials are used either as loose grit or as bonded grit.

Loose abrasive grain is usually washed to the proper degree of cleanliness and screened to a desired size and used, for example, on a lapping table or plate for glass grinding or lens making and as a gritty substance to pour on reciprocating steel saws for sawing minerals and building materials such as granite and marble. Loose abrasive grain is also used in sand blasting and in paper blasting. It may also be used as a charge in tumbling barrel operations. The other chief use of loose abrasive grain is as the main base material for bonded abrasive articles.

### Bonded Abrasives:

This group may be divided, for convenience, into three categories, namely rigid, semirigid, and flexible abrasive articles. These divisions reflect the needs for a host of shapes and sizes such as wheels, stones, hones, rubs, sheets, or belts.

In order to hold abrasive grains into a desired shape and with the right degree of tenacity, a variety of bonding materials is used, such as ceramic glasses and procelains, synthetic resins, hard and soft rubbers, shellac, self-hardening cements, silicate adhesives, sintered metals and metalloids, varnishes, and hide and casein glues. Each has its own special utility.

### Materials Ground:

We usually think of inorganic or structural materials in grinding but these are only part of all the things we grind. There are biological materials (such as fingernails) which require small coated abrasive strips for their trimming; the industry also provides fine coated abrasive for removing excess hair; and teeth are ground with a small abrasive wheel. But it is true that the materials most subjected to the use of abrasives are metals, wood, and minerals.

In the grinding wheel, the most used and commonest application, the sizes range from the tiniest mounted point perhaps  $\frac{1}{8}$  in. in diameter and  $\frac{1}{8}$  in. long to wheels 67 in. in diameter, 54 in. face. The latter, weighing 8 or 9 tons are used for grinding logs to make newsprint pulp.

Our high-speed machine age and its marvelous standard of living probably would not be possible without abrasives. We could never build our armament fast enough without them. Because of its contribution to national security we must preserve critical abrasive raw material sources.

## TECHNICAL COMMITTEE NOTES

### Committee B-1 Holds Two-Day Meeting in Cleveland

PROBABLY the most significant item taken up in the series of meetings in Cleveland, Ohio, on April 20 and 21, by Committee B-1 on Wires for Electrical Conductors, was a long consideration of direction of lay of aluminum stranded conductors in Subcommittee VII on Conductors of Light Metals.

At present all copper stranded conductors have their outer layer of wires as left-hand lay unless otherwise specified (Specifications B 8, B 172, B 173, and B 174). For aluminum stranded conductors, the direction of lay of the outer layer is right hand for classes AA and A, and left hand for other classes, unless otherwise specified (B 231). Class AA is bare conductors usually used in overhead lines. Class A is conductors to be covered with weather-resistant (weatherproof) slow burning materials, and for bare conductors in which greater flexibility is required than that afforded by class AA.

A letter-ballot vote in the subcommittee calling for all right-hand lay unless otherwise specified for all classes of all-aluminum stranded conductors resulted in a large number of negative votes. However, a motion that aluminum conductors be all right hand or all left hand received unanimous support. At present, the subcommittee is voting by letter on a proposal to have right-hand lay for overhead applications and left-hand lay for insulated conductors.

*Cold Welding Wire.*—It was reported that a process developed by the Utica Drop Forge and Tool Co., called "Kold-welding," butt welds wires of aluminum or copper without heat. If proved satisfactory, the present specifications will be revised to permit its use.

*Statistical Sampling.*—The committee is balloting on the inclusion of statistical sampling procedures in the Tentative Specifications for Soft or Annealed Copper Wire (B 3). This is the second specification under the jurisdiction of Committee B-1 to include statistical sampling, the other being the Tentative Specifications for Hard Drawn Copper Wire (B 1).

*New Standards.*—The committee is voting on a Proposed Tentative Method of Test for Stiffness of Bare Soft Square and Rectangular Copper Wire for Magnet Wire Fabrication. There has been a great deal of confusion on evalua-

tion of the stiffness of soft copper wire to be used for magnet wire, because of the variety of testing methods in use. This is the first step in an attempt to standardize these tests.

Proposed Tentative Specifications for Soft or Annealed Coated Copper Conductors for Use in Hook-Up Wire for Electronic Equipment are being developed in Subcommittee IV on Conductors of Copper and Copper Alloys. Flexible wire with very short lengths of lay will be covered.

*Other Revisions in Standards.*—Recently, consumers have encountered brittleness in aluminum wire which was not disclosed by the provisions of Specifications B 230, B 231, and B 232. A bend test to disclose this will be inserted. Also Specifications B 231 and B 232 will be revised to include a reference to the new Tentative Methods for Determination of Cross-Sectional Area of Stranded Conductors (A 263 - 53 T).

Specifications B 1 - 52 T will have footnote e of Table I revised to say that

the tensile strength values in Table I cannot be met where the wire is drawn into coils of 19 in. or less and not re-wound, and that lower tensile strength values are permissible when agreed upon.

Specifications B 9 for Bronze Trolley Wire will be revised to include a higher conductivity bronze and a figure-9 deep section grooved wire. In both Specifications B 9 and B 105 for Hard-Drawn Copper Alloy Wires for Electrical Conductors the words "class" and "grade" will be changed to read "alloy."

Through revisions at various times of the Tentative Specifications B 33 for tinned wire and B 189 for lead-coated wire the wording for similar requirements has become different. The specifications will be coordinated.

Specifications B 8, B 172, B 173, and B 174 for copper stranded conductors will be revised to refer to the new Tentative Method for Determining the Cross-Sectional Area of Stranded Conductors (B 263 - 53 T).

### Personnel Changes in B-4 Group Announced at Meeting

COMMITTEE B-4 on Electrical Heating, Resistance and Related Alloys met on June 25 and 26 at Atlantic City preceding the Annual Meeting. The committee acknowledged with regret the resignation of Fred E. Carter who has served as chairman of Subcommittee X on Contact Materials since its inception in 1940. Dr. Carter, who is retiring from Baker and Co., Inc., will be succeeded as chairman of Subcommittee X by J. D. Kleis, Fansteel Metallurgical Corp. Other changes in Committee B-4 administration include the appointment of A. M. Bounds, Superior Tube Co., to succeed T. H. Briggs as chairman of Section A on Cathodes of Subcommittee VIII (tube materials) and a new Corresponding Secretary, C. L. Guettel of Driver Harris Co.

The wrought and cast alloy group of B-4 is currently preparing specifications for tensile strength, creep rate, and ductility at elevated temperatures. This work will be done in collaboration with Committee A-10 and the Alloy Casting Institute. Emphasis on the "controlled atmosphere" work is shifting from oxidation to carburization. These

tests will be made at temperatures up to 2300 F and will include a wide variety of alloys. Consideration is being given to the adoption as standard Method B 233 - 51 T, Modulus of Elasticity of Thermostat Metals (Cantilever Beam Method) and Method B 106 - 51 T, Testing Thermostat Metals.

Development of a "standard triode" test is being prepared to supplement the so-called "standard diode test, B 270." Seven methods of measuring interface impedance are being evaluated with the hope that an ASTM test method can be developed. In cooperation with Committee E-3, methods of chemical analysis for cobalt, copper, iron, manganese, and titanium in nickel are nearing completion. Measurement of cathode camber is still an active subject as is the development of a suitable means of measuring out-of-roundness of fine wire such as is used for precision potentiometers. These wires are of the order of 0.001 in. in diameter.

A feature of the Subcommittee X meeting was a paper by V. J. Albano of Bell Telephone Laboratories on "Surface Films on Contacts."

## Analysis Standards Developed by Metal Powders Committee

In conjunction with the annual meeting of the Metal Powder Assn. at Cleveland, ASTM Committee B-9 on Metal Powders and Metal Powder Products held its own meetings April 20-22.

Committees B-9 and E-1 on Methods of Testing are working together on the addition to Method E-8 of two tension-test bars for metal powder products. Also being submitted to Committee E-1 are Tentative Methods for Subsieve Analysis of Granular Metal Powders by Air Classification.

Four methods of chemical analysis developed by Committee B-9 have been forwarded to Committee E-3 on Chemical Analysis of Metals for its consideration. The methods include the following:

1. Tentative Method of Chemical Analysis of Metal Powders.
2. Tentative Methods for Determination of Hydrogen Loss in Metal Powders.
3. Tentative Method for Determination of Iron Content of Iron Powders.

4. Tentative Method for Determination of Insoluble Matter in Iron and Copper Powders.

Now undergoing trials in a number of members' laboratories is a proposed method for determination of compressibility of metal powders. If found satisfactory, it will be balloted upon by the committee.

The term "sinterings" has become widely used by the industry as a name for metal powder products, and it is planned to include the term in Definitions B 243.

Increased activity has been shown recently in the cemented carbide field. In 1952 the Recommended Practice for Evaluating the Microstructure of Apparent Porosity on Cemented Carbides (B 276-52 T) was published. New standards under way in the subcommittee include recommended practices for hardness, density, and transverse strength in carbides. The possibility of setting up a classification of cemented carbides is being investigated.

## E-11 to Form a Liaison Group from Other Committees

PRIOR to the Annual Meeting, Committee E-11 on Quality Control of Materials extended an invitation to each of the other technical committees of the Society to designate a representative as an associate member. It is expected that these representatives will serve on a special subcommittee to consider problems involving the application of statistical methods. Considerable interest was evidenced in this request, and action was taken by a number of committees designating representatives to serve on Committee E-11.

Committee E-11 and its Advisory Committee held a meeting at ASTM Headquarters in Philadelphia on May 25 and 26. At that meeting plans were made to sponsor a Symposium on Design of Experiments which is planned for the 1954 Spring Meeting in Washington D. C., during the week of February 1. It is expected by means of this symposium to make available interesting information and examples used by various committees in developing and studying their investigative programs. Arrangements for the symposium are being made by W. J. Youden, National Bureau of Standards, chairman of a new task group on this subject, appointed by Committee E-11.

The committee also has task groups actively working on the following subjects: ASTM sampling plans; planning interlaboratory test programs; number of tests for a desired precision of an average; bulk sampling; smoothing empirical data, and precision and accuracy.

respectively, and more commonly known as the Sigler and James types, were reviewed editorially and will now be rewritten and prepared for publication information only. In addition, round-robin tests will be run to establish the use of a ground-glass plate as a secondary standard for use in connection with the leather heel used in the testing procedure.

The Section on Appearance reported on a method to measure wax deposits and on the study of methods of application of uniform wax films. The Section on Service Life is now preparing a draft of a water spotting test method which will be submitted to the subcommittee for letter ballot. The round-robin tests using three unknown waxes gave very uniform results for this proposed method.

## Draft of General-Purpose Floor Wax Specifications Under Way in D-21

THE writing of a draft specification on general-purpose floor waxes will now be undertaken by Committee D-21 on Wax Polishes and Related Materials. It was announced at the recent meeting of the committee held at the Drake Hotel, in Chicago, Ill., May 20 and 21, following the sessions of the Chemical Specialties Manufacturing Assn.

Subcommittee V on Specifications has been appointed a small task group to prepare the proposed specification, which will not necessarily be more than a framework at this time, to be filled in with proper requirements and test method references as they are developed. The subcommittee has now completed its review of descriptions of the various properties of floor waxes, which should be included in a specification. The other subcommittees concerned with test methods have been developing standard procedures in line with these significant properties.

Subcommittee I on Nomenclature is preparing a glossary which will include such terms as soil retention, soil acceptance, scuff, mar, water spotting, leveling, and spreading. One important definition being developed is that for the term "water emulsion waxes."

# 1953 Report of Advisory Committee on Corrosion

## Additional Contributions to Test Site Fund

THE old adage "one picture is worth 10,000 words" has been amplified 23 times in the appendix to the 1952 Report of the ASTM Advisory Committee on Corrosion.

In response to requests from several of the technical committees and to aid in describing the various test sites available under the ASTM test site program to other than ASTM interests, the Advisory Committee on Corrosion has published as an appendix to the 1953 Report, photographs of the 23 test sites now being used by the Society. Accompanying these photographs are brief descriptions of the type of environmental conditions prevailing at each site. The photographs are not intended to show specific types of specimens but are designed more to show the type of environment.

Figures 1 and 2 show two of the older sites still being used by the Society. The site at State College,

Pa., is one which will continue to be used and is quite typical of the rural areas of the country. This site, established in 1925, has been expanded and there is currently somewhat more than half an acre of ground. A part of the several thousand specimens exposed at State College is shown in Fig. 1 and as can be seen, the area is gently rolling. There is no industry of any kind in the area.

On the other hand, the industrial site at Altoona, Pa. (Fig. 2) is located on the 4th floor roof of the Pennsylvania Railroad general office and storehouse building at the Juniata shops. Adjacent to the Juniata shops the railroad has a large classification yard and the specimens at this test site are subjected to extensive fumes from both coal burning and diesel powered locomotives. As can be seen, the area available is somewhat restricted as to size and this is one of the sites that

will undoubtedly be discontinued when the present tests are completed.

## Exposure Programs

An extensive review of technical committee exposure programs was included in the 1952 Report of the ACC. The 1953 Report lists briefly only new or continuing tests, for example, sheet and wire tests of Committee A-5, Subcommittees VII and VIII of Committee B-3, Committees B-6, B-7, and B-8.

## Additional Contributors to ASTM Test Site Fund

It is gratifying to realize that contributions are still being made to the exposure work of the Society. Since January of this year \$1500 has been received which includes contributions from

Ford Motor Co.

Heyden Chemical Corp.

Western Union Telegraph Co.

Although the original solicitation of funds for this work was envisaged as at least \$100,000 to cover the work for ten years, it is certain that the programs will continue for a longer period and the test site fund may have to be augmented at some future date. Naturally if there are companies or individuals who wish to contribute to this work, but have not done so, such contributions would still be gratefully acknowledged. Checks should be drawn to the ASTM Test Site Fund and sent to the Executive Secretary of the Society, 1916 Race Street, Philadelphia 3, Pa.



Fig. 1.—State College, Pa.

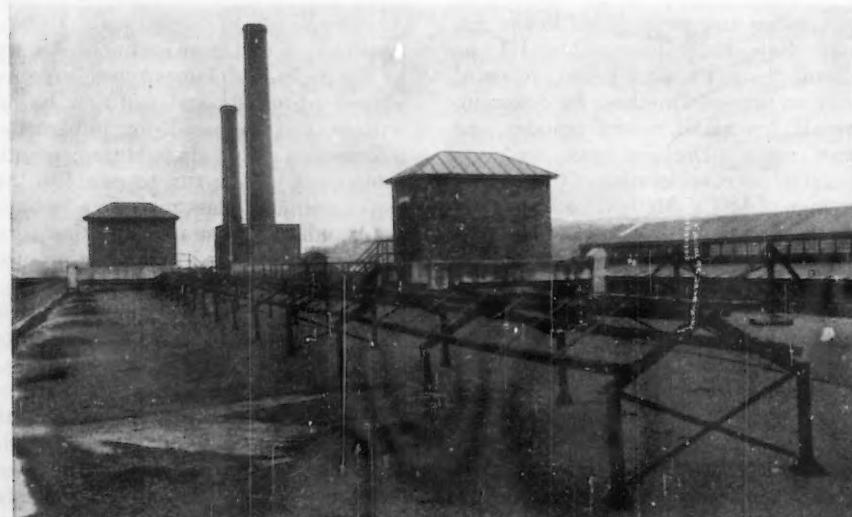


Fig. 2.—Altoona, Pa.

## Colorimetry Terms Covered in ASA Standard

A NEW American Standard—Nomenclature and Definitions in the Field of Colorimetry—has been prepared by the ASA Sectional Committee Z58, under sponsorship of the Optical Society of America.

This standardization has been applied only to terms that have come into general use in practical applications of color measurement. Sections cover, in addition to general terms, color-mixture data, chromaticity diagram, luminators, and colorimetric calculations.

Copies of this standard, Z58.1.2-1952, can be obtained from the ASA, 70 E. 45th St., New York 17, N. Y., for 50 cents.

# Some Unsolved Problems

## Committees Submit Intriguing Questions: What We Know and What We Would Like to Know

**A**BOUT three years ago the ASTM Administrative Committee on Research requested the various technical committees to submit their current research problems. These statements were reviewed by the ACR and the decision taken that such problems be published serially in the ASTM BULLETIN and reprinted for distribution to various engineering and scientific schools and to research institutions and testing laboratories as a suggested basis for possible research work.

This reprint pamphlet has been revised and expanded to include additional problems which will appear in this and subsequent issues of the BULLETIN.

The revised pamphlet can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

Appearing in this issue as the first of the new series of problems are:

- Mechanism of Stress Corrosion Cracking
- Chromate Conversion Coatings
- Applications of the Spectrograph to Chemical Analysis of Refractory Products
- Disintegration of Refractories by the Deposition of Carbon from Carbon Monoxide

### Mechanism of Stress Corrosion Cracking

*Statement of Unsolved Problem Contributed by Advisory Committee on Corrosion*

#### Problem:

Many metals or alloys when exposed to mildly corrosive environments in a stressed condition will develop cracks. Disastrous failures of structural members can result from such stress corrosion cracking. It is particularly unfortunate that frequently the conditions that cause the most rapid stress corrosion cracking failures are those which give only mild or negligible general corrosion. Thus, a stressed part that appears uncorroded to the eye may suddenly fail by stress corrosion cracking. For certain specific metals or alloys in specific environments, the mechanism of stress corrosion cracking appears to be well established. For many other metals or alloys in numerous environments no reasonable mechanism has yet been proposed. Several different mechanisms may be active under different conditions. Sustained research is necessary to provide a better understanding of the causes of this disastrous form of corrosion.

#### Present State of Knowledge:

The "season cracking" of brass and the "caustic embrittlement" of steel boilers have been known for years. Both of these phenomena appear to be examples of stress corrosion cracking. Much has been written about these types of failure but the mechanism is still obscure. The mechanism of the intergranular stress corrosion cracking of the duralumin type alloys appears to be fairly well established but the mechanism of transgranular stress corrosion cracking of magnesium-base alloys and of austenitic stainless steels is not understood. A summary of current knowledge of stress corrosion cracking is available in the book entitled "Symposium on Stress Corrosion Cracking of Metals" that was published jointly by the ASTM and the AIME in 1944. More recent publications on this subject are listed in the Introductory References.

#### Questions That Need to Be Answered:

1. Just what is the effect of stress in promoting stress corrosion cracking?
2. Why is the path of stress corrosion cracks transgranular in some cases and intergranular in others?
3. Is the mechanism of all stress corrosion failures electrochemical in nature?
4. If large numbers of stressed specimens of a specific metal or alloy are exposed simultaneously, why do some specimens fail by stress corrosion cracking while similar specimens do not?
5. How can stress corrosion cracking be prevented?

#### Introductory References:

- (1) "Symposium on Stress Corrosion Cracking of Metals," Published in 1944 jointly by the American Society for Testing Materials and the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers.
- (2) D. H. Thompson and A. W. Tracy, "Influence of Composition on the Stress-Corrosion Cracking of Some Copper-Base Alloys," *Journal Metals*, Vol. 1, No. 2, *Transactions*, pp. 100-109 (1949).
- (3) J. T. Waber, H. J. McDonald and B. Longtin, "Theory of Stress-Corrosion Cracking of Mild Steel in Nitrate Solutions," *Transactions, Electrochemical Soc.*, Vol. 87, p. 209 (1945).
- (4) H. H. Uhlig, "Action of Corrosion and Stress on 13 Per Cent Chromium Stainless Steel," *Metal Progress*, Vol. 57, pp. 486-487 (1950).
- (5) H. L. Logan and Harold Hessing, "Stress Corrosion of Wrought Magnesium Base Alloys," *Journal Research, National Bureau of Standards*, Vol. 44, p. 233 (1950).
- (6) P. T. Gilbert and S. E. Hadden,

"The Theory of the Mechanism of Stress Corrosion in Aluminum-7 Per Cent Magnesium Alloy," *Journal, Inst. Metals*, Vol. 77m, pp. 235-261 (1950).

(7) J. J. Harwood, "The Influence of Stress on Corrosion," *Corrosion*, Vol. 6, pp. 249-259; pp. 290-307 (1950).

Additional information may be obtained from R. B. Mears, Manager, Research and Development Laboratory, United States Steel Corp., Pittsburgh 13, Pa.

### Chromate Conversion Coatings

*Statement of Unsolved Problem Contributed by Committee B-8 on Electro-deposited Metallic Coatings*

#### Problem:

Acidified chromate type conversion coatings are widely used on zinc, cadmium, aluminum, magnesium, copper, and copper alloys. They provide corrosion protection and a good base for subsequent organic materials if used. At the present time, little or nothing is known regarding the reaction which takes place in forming chromate conversion coatings, the analysis of, or thickness of the film so formed.

#### Present State of Knowledge:

Information now available enables the control chemist to maintain chromate conversion coating solutions by adjusting and maintaining within a given pH and hexavalent chromium range. The protective value of the coating can be comparatively determined by accelerated testing under such conditions as salt fog, humidity, etc.

The conversion coating is known to contain varying percentages of hexavalent and trivalent chromium. The physical structure of the film is apparently amorphous. If the coating is heated to 200 F or more, however, the structure changes to crystalline and is, basically chromium chromate. This heating reduces protective value under salt fog test but adds to the abrasion resistance and also increases resistance to mild acids and alkalies.

Conversion coating solutions on some metals can be made to form heavy coatings or chemically polished surfaces with thin coatings by varying concentration and pH. Color of coatings can be made to vary from clear through iridescent yellow, bronze, brown, and olive drab.

#### Questions That Need to Be Answered:

1. What chemical reaction takes place in producing the chromate conversion type coatings on the metals listed?
2. What is the composition of the coatings formed on each of these metals?
3. What change takes place when the coating is heated to 200 F or more?

4. How does the composition of the coating affect the protective value of the coating under such exposures as salt spray and outdoor weathering?

5. What are the relative thicknesses of the different types of films on the metals mentioned?

#### Introductory References:

(1) E. A. Anderson, "The Cronak Process," *Proceedings, Am. Electroplaters Soc.*, June, 1943, pp. 7-12.

(2) V. Mattacotti, "Conversion Coatings on Zinc," *Products Finishing*, Feb., 1950, pp. 52-72.

(3) H. C. Irvin, "Chromate Finishes in War and Peace," *Metal Finishing*, July, 1951.

(4) George Black, "Chromate Finishes to Protect Zinc Surfaces," *Materials and Methods*, April, 1947.

(5) C. W. Ostrander, "Chromate Treatments," *Plating*, Oct., 1951.

(6) R. Stricklen, "New Protective Treatment for Aluminum Simplifies Processing at Reduced Costs," *Materials and Methods*, Feb., 1952.

Additional information may be obtained from C. W. Ostrander, Service Manager, Allied Research Sales Corp., subsidiary of Allied Research Products, Inc., 4004-06 E. Monument St., Baltimore, 5, Md.

### Application of the Spectrograph to Chemical Analysis of Refractory Products

*Statement of Unsolved Problem Contributed by Committee C-8 on Refractories*

#### Problem:

Higher quality standards for refractory products have steadily increased the demand for chemical analyses but little has been accomplished to speed up the analyses, which in most cases are notoriously slow and laborious by present procedures. The limited use of the spectrograph in the chemical analysis of certain refractories such as silica brick has indicated that relatively rapid analyses for some elements, present as low percentages, can be made on a routine basis. Studies should be made of its applicability to a larger number of such elements, and the eventual goal is the determination of the major elements as well.

#### Present State of Knowledge:

The greatest use of the spectrograph in the quantitative chemical analysis of refractories has been in the determination of the minor constituents, alumina, iron oxide, titania, alkalies, lime and magnesia in silica brick. Other uses, such as the determination of sodium and silica in commercial alumina and the minor oxides in portland cement, are described in the literature. Accuracies of 3 to 5 per cent of the oxide sought are claimed in most cases. Such accuracy is insufficient for the major oxides, such as the  $\text{Al}_2\text{O}_3$  and  $\text{SiO}_2$  in fireclay brick.

#### Questions That Need to Be Answered:

1. What are the upper limits of concentration of the minor oxides commonly

determined in refractories that can be handled effectively by spectrographic methods?

Individual aspects of this problem, each worthy of separate study, include  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{Fe}_2\text{O}_3$ ,  $\text{MnO}_2$ , and  $\text{CaO}$  in magnesite refractories;  $\text{Fe}_2\text{O}_3$ ,  $\text{TiO}_2$ ,  $\text{CaO}$ ,  $\text{MgO}$ , and the alkalies in fireclay and high alumina refractories;  $\text{SiO}_2$  and  $\text{CaO}$  in chromite refractories.

2. Can the determination of minor oxides by spectrographic methods be combined with the determination of the major oxides by chemical methods so as to appreciably shorten the time required for complete chemical analysis of refractories?

Separate studies are needed on spectrographic determination of such major elements as  $\text{MgO}$  in magnesite or dolomite refractories;  $\text{CaO}$  in the latter;  $\text{Al}_2\text{O}_3$  and  $\text{SiO}_2$  in fireclay and high alumina refractories;  $\text{MgO}$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{Fe}_2\text{O}_3$ , and  $\text{Cr}_2\text{O}_3$  in chromite refractories.

#### Introductory References:

(1) H. C. Harrison and L. B. Bassett, "Emission Spectroscopy and Its Application in Investigation and Solution of Problems in Ceramics," *Journal, Am. Ceramic Soc.*, Vol. 24, pp. 213-221 (1941).

(2) J. R. Churchill and R. G. Russell, "Analysis of Aluminous Ore by Means of Spark Spectra," *Industrial and Engineering Chemistry, Anal. Ed.*, Vol. 17, No. 1, pp. 24-27 (1945).

(3) R. W. Smith and J. E. Hoagbin, "Quantitative Spectrographic Analysis of Ceramic Materials," *Journal, Am. Ceramic Soc.*, Vol. 29, pp. 222-228 (1946).

(4) A. W. Helz and B. F. Scribner, "Spectrographic Determination of Minor Elements in Portland Cement," *Journal of Research, RP 1786*, National Bureau of Standards, Vol. 38, pp. 439-447 (1947).

(5) J. T. Rozsa, "Improvement of Analytical Control for Silica Brick," *Journal, Am. Ceramic Soc.*, Vol. 31, pp. 280-283 (1948).

Additional information may be obtained from R. E. Birch, Chairman of Subcommittee II on Research of Committee C-8, Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh 22, Pa.

### Disintegration of Refractories by the Deposition of Carbon from Carbon Monoxide

*Statement of Unsolved Problem Contributed by Committee C-8 on Refractories*

#### Problem:

In a temperature range approximating 700 to 1100 F, in furnace atmospheres high in carbon monoxide (such as that in the iron blast furnace) the following reaction, actively catalyzed by iron compounds in the refractory, may take place:



The resulting carbon forms a graphitic deposit at the catalyst centers within the brick and may weaken them or eventually

cause disintegration. The reaction is influenced by many factors, so that the performance of the refractories in service and presumably in the ASTM Tentative Method for Disintegration of Fireclay Refractories in an Atmosphere of Carbon Monoxide (C 288 - 52 T)(1) is often unpredictable and subject to vagaries.

Knowledge is needed which will allow better control of the variables of the test. As in other testing work, the eventual goal is improved service life of the refractories.

#### Present State of Knowledge:

The ASTM Method C 288 prescribes conditions which will cause disintegration.

#### Questions That Need to Be Answered:

1. Would X-ray patterns of the iron oxide catalyst at the temperature of reaction give exact knowledge of its constitution? Baukloh has suggested that only metallic iron catalyzes.

2. Are impurities in the CO a principal cause of variable results, and possibly of the protection often seeming to exist in service?

3. In the test method, what is the temperature at which the rate of carbon deposition is the greatest? The effect of rate of flow of CO? The effect of small percentages of  $\text{CO}_2$  on deposition rate?

#### Introductory References:

(1) 1952 Book of ASTM Standards, Part 3, p. 597.

(2) C. E. Nesbitt and M. L. Bell, "The Disintegration of Fire Brick Linings in Iron Blast Furnaces," *Year Book, Am. Iron and Steel Inst.* (1923).

(3) F. Olmer, "Decomposition of Carbon Monoxide by Ferromagnetic Metals," *Journal Physical Chemistry*, Vol. 46, p. 405, March, 1942.

(4) W. Baukloh and E. Spetzler, "Influence of Gaseous Admixtures on Decomposition of Carbon Monoxide," *Archiv für das Eisenhüttenwesen*, Vol. 13, p. 223, 1939-1940; Brutcher Translation 1069.

(5) James A. Shea, "Treatment of Brick to Prevent CO Disintegration," *Iron and Steel Engineer*, p. 116, December, 1950.

(6) L. J. Trostel, "Carbon Disintegration Test for Blast Furnace Brick," *Journal, Am. Ceramic Soc.*, Vol. 34, p. 76, March, 1951.

(7) "Proposed Method of Test for Disintegration of Fireclay Refractories in an Atmosphere of Carbon Monoxide," Manual of ASTM Standards on Refractory Materials, p. 135 (1952).

(8) S. Klemantaski, "The Action of Inhibitors of Carbon Deposition in Iron Ore Reduction," *Journal, British Iron and Steel Inst.*, Vol. 171, Part II, p. 176, June, 1952.

Additional information may be obtained from R. E. Birch, Chairman of Subcommittee II on Research of Committee C-8, Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh 22, Pa.

# People and Things

Annual Address by the President

H. L. Maxwell, June 30, 1953

MY FIRST thought in seeing you here today is to tell you how grateful I am for the opportunity you entrusted to me a year ago. This year's tour of duty has been a challenge at this particular time. It was an honor to follow the course surveyed and fortified so well by my 45 predecessors in this office. This is the closing week of my year—a very pleasant year—during which I have met and visited with hundreds of ASTM members, some for the first time. It makes one increasingly aware of the personal, even fraternal, bond that unites us.

The official report of the Society's activities for the year is already in your hands. A further elaboration of the financial and technical achievements would be repetitious and therefore inappropriate.

More appropriately, I want to convey to you some of the confident assurance that characterizes our Board of Directors and the Executive Committee, and shared also by the Headquarters Staff. I can best express, briefly, that feeling of the Society's well-being, now as we are entering into our second half century, by borrowing from William Wordsworth who wrote in his confident summary:

No fears to beat away—  
No strifes to heal,  
The Past is unsighed for, and the future  
sure.

During the year now closing I have traveled many miles and have spoken at most of the District meetings and several colleges, invariably on technical subjects. For today, I shall use my temporary prerogative, which I shall forfeit now in a few days, and speak on a new topic, "People and Things" for this, my twilight appearance.

Whatever kind of daily work occupies our time and energy, whether it is in designing chemical plants or whipping up a soufflé, whether it is teaching calculus or riding in a roller chair on the boardwalk; our every action—every day—is concerned directly with either people or things or both. The relative priority we as free moral agents recognize in dealing with people and things determines in large measure what kind of individuals we are. It is safe to say that we are drawn naturally to an associate who respects people and uses

things. We are just as naturally repelled by one who respects things and uses people.

The ASTM, as a result of careful and forward looking management, has, over the years, accumulated considerable property. We members have a fine building, an additional building lot, some stocks and bonds, and in fact quite a few valuable things as measured on a cash basis. But, by far, the greater value is represented by the individual people, the men and women, who make up the membership, the committees, and Staff of the Society.

Let me illustrate that point. If by some strange and regrettable coincidence all of the physical assets of our Society, including building and financial reserves, were totally destroyed but all of the Society's membership and Staff left intact and active, we would suffer no more than a temporary inconvenience. We would still be in business. We would still be at the lead of the technical societies, taking all steps to replace the physical facilities.

If, on the other hand, our Society's physical assets, including building and land and financial resources, remained unchanged and by some catastrophic misfortune the entire membership and Staff were blotted out, the motivating element which is essential for going ahead would be irretrievably lost and the material assets would be lifeless.

Make these and other comparisons by any standards of value you choose, and without exception you come to the inevitable conclusion that material things have value only to the extent that they, ultimately, satisfy some human need.

In every day of our lives, the superiority of people over things is emphasized in many ways. Take, for instance, modern aviation. Some of you, as I, have been in a modern airplane, poised on the runway on the outermost tip of Newfoundland waiting for a favorable radio release on the weather. And when a description of the weather came over the radio, the pilot, belonging to the only species in the whole of the animal kingdom with ability to reason, called on his judgment and made a decision that literally determined matters of life and death for every passenger. And then—we took off that night and traveled through a vast and dark and freezing emptiness, guided unerringly by

instruments that were conceived only in the mind of men. Those modern instruments were built as rugged as a blacksmith's anvil—yet fantastically accurate. They were truly the electronic counterpart of the sensitive fingertips of the man who designed them. These mechanical eyes, seen yet unseeing in the usual sense, guided the great plane through the stillness of the Arctic night. Crossing first over the dark green patchwork of rural Ireland, we came to a welcome landing beyond the rugged barren mountains of North Scotland.

And the plane itself—as sturdy and buoyant and graceful as it appeared in the air—yet it was without life and entirely incapable of action unless motivated by the hand and heart and mind of a human being. Materials, alone, are not enough. Steel and plastic and rubber, that made up the plane, have no personality; copper wire and aluminum and fabrics have no memory and do not respond to incentives. Only man has been given that divine spark that transforms an organic bit of matter into a being capable of thought and love and worship.

However, if we appear in our ardent enthusiasm to overemphasize that last point, we call attention at the same time to man's definite limitations. For one thing, we humans are in fact a presumptuous lot. In the history of this world, we are now only a relatively few years advanced from the time our ancestors swung among the branches of primeval forests. Presumptuous are we also, when we boast of our scientific accomplishments, when the greatest scientific achievement of the century is one which is literally driving us underground, in unwilling retreat from our own cleverness. Presumptuous are we even in our moments of meditation when we approach the Infinite, without ourselves being able to comprehend the infinitesimal. Perhaps you have heard prayers that sound like a man telling God how to run the world instead of expressing the allegiance of one reporting for duty.

The emphasis and appreciation of people over things calls, oftentimes, for a good share of unselfishness and even humility—dignified humility. This is found frequently among the men and women who have made noteworthy contributions in science and art and

music and medicine. They have been so engrossed in the individual field in their services to humanity that they discount their own personal needs and discomforts. Many of them are interested only in worthy ideals and perfection of their handiwork in the service of their fellow man. They are least of all interested in material things. Some are not concerned whether their house furnishings go back to Louis the 14th or whether they go back to Sears & Roebuck on the 30th.

There is recognized here a seeming lack of agreement—an apparent conflict between values as they are and values as they ought to be. But, actually, there is no inconsistency. We can say with due regard for fact that we actually live in two different worlds. One of the worlds is the one we as engineers measure with transit and line and rule. The other world is the one we feel with our hearts and our imaginations. It is in this second category, strange as it may appear, that we find the origin of many

of the great developments in industry and architecture and the sciences. Almost axiomatically, one cannot either devise a new process or product or construct a plant to produce it until it is clearly conceived in the imagination.

Therein lie some of the dominant differences between things and people, and the chief difference is in their relative permanency. The sensitive balance of the scientists, the transit of the engineers, and the palette knife of the artist of whatever source and of whatever value, measured solely by the yardstick of cash, are inert, without life and are valueless unless held by the hand of man. But with qualities of people—that's different. We all know that traits of character, ideals, and loyalties are transmitted from generation to generation, endlessly, across that narrow biological bridge of a single microscopic cell.

Transcending in importance all of the engineering materials and things is the welfare and development of the men who

work with materials and things. And that is why we feel that to be entrusted with the supervision of other men and their work is like taking a solemn obligation—one which cannot be repudiated or laid aside. We believe, devotedly, that the greatest opportunity open to an individual is the opportunity afforded a man to grow with his responsibilities. And in this way we pay tribute to the dignity and well-being of people and to the usefulness of things. People are infinitely more important than things.

Edward Markham must have been meditating along these lines when he seized upon a basic thought and groomed it with poetic rhythm. This I leave with you in closing:

We all are blind until we see  
That in the human plan  
Nothing is worth the making  
If it does not make the man.  
Why build these cities glorious  
If man unbuilds goes,  
In vain we build the world, unless  
The builder also grows.

## Calender of Other Society Events

"Long" and "short" calendars will appear in alternate BULLETINS. The "short" calendar notes meetings in the few immediate weeks ahead—the "long" calendar for months ahead.

INTERNATIONAL EXPOSITION FABRICS, FIBERS, FINISHES, YARNS—July 27-31, Waldorf-Astoria Hotel, New York City, N. Y.

SOCIETY OF AUTOMOTIVE ENGINEERS—Aug. 17-19, International West Coast Meeting, Georgia Hotel, Vancouver, Canada.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—Aug. 18-21, Pacific General Hotel, Vancouver, Canada.

INTERNATIONAL ASSOCIATION FOR HYDRAULIC RESEARCH—Aug. 31-Sept. 5, Joint Meeting with Hydraulics Div. of the American Soc. of Civil Engineers, Minneapolis, Minn.

AMERICAN CHEMICAL SOCIETY—Sept. 6-11, 124th National Meeting, Chicago, Ill.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS—Sept. 13-16, Mark Hopkins Hotel, San Francisco, Calif.

ELECTROCHEMICAL SOCIETY, INC.—Sept. 13-16, Sessions on Corrosion, Electrodeposition, and Battery, Ocean Terrace Hotel, Wrightsville Beach, N. C.

SOCIETY OF AUTOMOTIVE ENGINEERS—Sept. 14-17, National Tractor Meeting & Production Forum, Schroeder Hotel, Milwaukee, Wis.

NATIONAL FOUNDRY ASSOCIATION—Sept. 16-18, Annual Meeting, Plaza Hotel, New York City, N. Y.

NATIONAL PETROLEUM ASSOCIATION—Sept. 16-18, 51st Annual Meeting, The Traymore, Atlantic City, N. J.

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS—Sept. 17-19, Annual Convention, Conrad Hilton Hotel, Chicago Ill.

STEEL FOUNDERS' SOCIETY—Sept. 21-22, Fall Meeting, Homestead, Hot Springs, Va.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS—Sept. 21-25, Joint IIRD-ISA Conference and Exhibit, Sherman Hotel, Chicago, Ill.

INSTRUMENT SOCIETY OF AMERICA—Sept.

21-25, Eighth National Instrument Conference and Exhibit, Chicago, Ill.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS—Sept. 28-30, Petroleum Mechanical Engineering Conference, Rice Hotel, Houston, Tex.

ASSOCIATION OF IRON AND STEEL ENGINEERS—Sept. 28-Oct. 1, Annual Convention, William Penn Hotel, Pittsburgh, Pa.

SOCIETY OF AUTOMOTIVE ENGINEERS—Sept. 29-Oct. 3, National Aero. Meeting, Aircraft Engineering Display, and Aircraft Production Forum, Statler Hotel, Los Angeles, Calif.

AMERICAN CERAMIC SOCIETY—Oct. 2-3, Materials and Equipment, White Wares, Bedford Springs Hotel, Bedford, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—Oct. 5-7, Fall Meeting, Hotel Sheraton, Rochester, N. Y.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS—Oct. 7-9, Mayo Hotel, Tulsa, Okla.

GRAY IRON FOUNDERS' SOCIETY—Oct. 8-9, Annual Meeting, New Hotel Jefferson, St. Louis, Mo.

FEDERATION OF SEWAGE AND INDUSTRIAL WASTES ASSOCIATIONS—Oct. 13-16, Annual Convention, Municipal (Bayfront Park) Auditorium, Miami, Fla.

CONFERENCE ON ELECTRICAL INSULATION—Oct. 19-21, Annual Meeting, Pocono Manor Inn, Pocono Manor, Pa.

AMERICAN SOCIETY OF CIVIL ENGINEERS—Oct. 19-23, Annual Convention, Hotel Statler, New York City, N. Y.

AMERICAN SOCIETY OF METALS—Oct. 19-23, National Metal Congress & Exposition, Hotel Statler, Cleveland, Ohio.

AMERICAN WELDING SOCIETY—Oct. 19-23, 33rd Annual Meeting, Hotel Cleveland, Cleveland, Ohio.

AMERICAN GAS ASSOCIATION—Oct. 26-29, Annual Conference, Kiel Auditorium, St. Louis, Mo.

ASSOCIATION OF CONSULTING CHEMISTS AND CHEMICAL ENGINEERS—Oct. 27, Annual Meeting, Hotel Belmont Plaza, New York N. Y.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS—Oct. 29-30, Fuels-AIME Coal Conference, Conrad Hilton Hotel, Chicago, Ill.

SOCIETY OF AUTOMOTIVE ENGINEERS—Oct. 29-30, International Production Meeting, Royal York Hotel, Toronto, Ont., Canada.

## Report Reveals Expansion at Armour Research

SCIENTIFIC contributions to industry, national defense, and the public highlight the 64-page illustrated annual report of Armour Research Foundation of Illinois Institute of Technology.

In reviewing the record of the Foundation for the past year, the Foundation's Director, Dr. Haldon A. Leedy, emphasized the close cooperation between science and industry. He said:

"Research scientists and industry, working hand in hand, have envisioned, developed, and perfected the products and processes that helped give America its unparalleled standard of living."

"The partnership, a unique phenomenon of the twentieth century, has been a happy and successful one for both science and industry. Together, they have solved hundreds of industrial problems; together, they have kept pace with the complex demands of a technological civilization."

Sponsored by industry, governmental agencies, and the Foundation itself, the projects represent an expenditure in excess of \$8,000,000, an increase of 30 per cent over the previous year.

Through its International division, the Foundation has been contributing since 1942 to the technological development of the world's free nations. During the past year, this group's diverse services were used by sponsors in Mexico, India, Pakistan, Italy, Germany, South America, Costa Rica, and the West Indies.

# The Temperature Rise Test to Determine the Relative Amounts of Phases I and II in Sodium Triphosphate

By J. D. McGilvery<sup>1</sup>

**N**UMEROUS investigators (1,2,3,4,5)<sup>2</sup> have demonstrated by X-ray diffraction methods that sodium triphosphate occurs in two crystalline modifications. Phase I ( $\text{Na}_5\text{P}_3\text{O}_{10}$ -I), the high-temperature form, is stable at temperatures from about 470°C to the melting point (622°C). Phase II ( $\text{Na}_5\text{P}_3\text{O}_{10}$ -II) at temperatures below about 470°C. However, the transition, Phase I  $\rightarrow$  Phase II, is extremely slow when the material is in a finely divided form, and as a result any Phase I formed in the preparation of sodium triphosphate by the dehydration of orthophosphate mixtures below the melting point of sodium triphosphate (the usual commercial procedure) invariably remains almost unchanged in the cooled product. Therefore, unless close temperature control has been maintained in the calcination kilns, appreciable quantities of Phase I will be found in commercial samples of sodium triphosphate. The commercial material is frequently called sodium tripolyphosphate and is used extensively in the manufacture of detergent mixtures. From a practical standpoint, a high content of Phase I is undesirable because of its tendency to form hard lumps when mixed with water. On occasions the whole detergent mixture has been known to solidify into a hard mass which is very difficult to remove from the mixing vessels. Therefore the determination of the Phase I content of commercial preparations is important and is currently being used in purchase specifications.

The only satisfactory method for the unequivocal determination of Phase I content is by X-ray diffraction. Such methods have been described by Raisbrick (6) and by Mabis and Quimby (7). However, using X-ray diffraction analyses for calibration, Procter and Gamble developed a Temperature Rise Test which is rapid, requires a minimum of equipment, and is suitable for plant work. The test is as follows:

**NOTE.—DISCUSSION OF THIS PAPER IS INVITED,** either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

<sup>1</sup> Research Fellow, Electric Reduction Company Fellowship, Dept. of Chemistry, Ontario Research Foundation, Toronto, Canada.

<sup>2</sup> The boldface numbers in parentheses refer to the list of references appended to this paper.

Place 50.0 g of sample in a 100-ml beaker. In a 150-ml beaker weigh 50.0 g of glycerin. Add the sample to the glycerin and stir with the thermometer to a smooth paste. Wait one minute, and stir once or twice. Leave the thermometer suspended in the center of the paste and  $\frac{1}{8}$  in. from the bottom of the beaker. Wait 1 to 2 min for the temperature to become constant and record this as the "Paste Temperature."

Adjust a flask of water to the temperature of the paste within 0.1°C. Rinse a pipet and graduate and then pipet exactly 25.0 ml into the wetted graduate. Add the water quickly to the paste with immediate stirring and continue for 45 sec. Watch the temperature until it reaches a maximum and drops 0.1°C and record the maximum temperature.

$$\text{Temperature Rise} = \frac{\text{Max. Temp.} - \text{Paste Temp.}}{4(\text{Temperature Rise (deg Cent)} - 6)}$$

**NOTE.—**The sample and paste should be about normal room temperature before starting the test.

When the Phase I content is less than about 30 per cent the relation between temperature rise and per cent Phase I is given approximately by the equation

$$\text{per cent Phase I} = 4(\text{Temperature Rise (deg Cent)} - 6)$$

The present work was undertaken in an attempt to discover the mechanism of the test and also to ascertain what factors other than Phase I content might affect the temperature rise observed.

## Heat Evolution Measurements:

If it is assumed that both phases yield the same ions on solution,<sup>3</sup> then, since Phase I is metastable with respect to Phase II at ordinary temperatures, it is to be expected that Phase I will evolve more heat on solution since less heat will be absorbed in breaking down the crystal lattice. To determine whether this factor alone could explain the Temperature Rise Test, the heats of solution in pure water of Phase I, Phase II, and the hexahydrate were measured.

A wide-mouth, pint-size, silvered

<sup>3</sup> This is substantiated by failure to obtain any separation by filter paper chromatography.

Dewar flask was used as the calorimeter vessel. Into this vessel were inserted an electrical heating coil, a Beckmann thermometer, a stirring propeller, and a thin-walled glass bulb containing from 3 to 8 g of the sample. The system was equilibrated for at least 20 min. Temperature measurements were made as a function of the time over a subsequent 20-min period to determine the rate of temperature rise from the stirring. The bulb was then broken and the temperature observed until the rate of heat entry was again linear with time. By extrapolation of the two linear portions of the curve, the temperature change due to solution was measured. To determine the system heat capacity, careful measurements were made of the voltage, current, and heating period necessary to effect by means of the heating coil a temperature change similar in magnitude.

The samples of sodium triphosphate were prepared in the following manner:

$\text{Na}_5\text{P}_3\text{O}_{10} \cdot 6\text{H}_2\text{O}$	—recrystallized twice from aqueous solution using methanol as precipitant,
$\text{Na}_5\text{P}_3\text{O}_{10}$ -I	—by heating the hexahydrate to 590°C for 4 hr and chilling on a steel plate,
$\text{Na}_5\text{P}_3\text{O}_{10}$ -II	—by heating the hexahydrate at 350°C for 22 hr and cooling in a desiccator.

In the following table are shown the results obtained:

Material	$\Delta H$ , kcal per mole	Standard Deviation, $\sigma$	Number of Measurements, $n$
$\text{Na}_5\text{P}_3\text{O}_{10}$ -I	-16.1	$\pm 0.09$	3
$\text{Na}_5\text{P}_3\text{O}_{10}$ -II	-14.0	$\pm 0.13$	3
$\text{Na}_5\text{P}_3\text{O}_{10} \cdot 6\text{H}_2\text{O}$	+2.6	$\pm 0.15$	3

The values for the anhydrous triphosphate have not previously been reported to the author's knowledge. The value for the hexahydrate is in good agreement with the value of 2.78 kilocalories (kcal) per mole reported by Bonneman-Bémia (8).

The heats of solution of Phases I and II in a solution containing about 25 g of sodium triphosphate per 100 ml were also determined. This solution is greatly supersaturated with respect to

$\text{Na}_5\text{P}_3\text{O}_{10} \cdot 6\text{H}_2\text{O}$  which has an equilibrium solubility of about 14.7 g of sodium triphosphate per 100 g of water at 25°C. The following results were obtained:

Material	$\Delta H$ , kcal per mole
$\text{Na}_5\text{P}_3\text{O}_{10}\text{-I.}$	-18.5
$\text{Na}_5\text{P}_3\text{O}_{10}\text{-II.}$	-16.9

The difference between these values and those obtained in pure water is roughly equal to the heat of crystallization of  $\text{Na}_5\text{P}_3\text{O}_{10} \cdot 6\text{H}_2\text{O}$ , suggesting that all of the added material hydrated and recrystallized as the hexahydrate without provoking crystallization to any extent of the supersaturated solution. It would appear also that the heats of solution in dilute and concentrated solution are not greatly different.

If now these heat of solution data are applied to the Temperature Rise Test system, it is manifest that the relation between temperature rise and Phase I content cannot be attributed to the difference in the potential heat of hydration available. Samples of Phase II prepared in a small rotary kiln consistently gave temperature rise values of 5.5°C. Assuming a system heat capacity of 75 cal per deg and a heat of hydration of -16.9 kcal per mole, it is estimated that less than 10 per cent of the Phase II is hydrated when the maximum temperature is reached. A series of experiments in which the amount of sodium triphosphate used in the Temperature Rise Test was progressively decreased indicated that this same small percentage of hydration was maintained down to about 30 g of Phase II added. On the other hand, similar experiments and calculations with Phase I indicated that at least 90 per cent of this material was hydrated at the time of maximum temperature.

It is clear that glycerin in some manner inhibits the rate of hydration of Phase II but is relatively ineffective against Phase I. Indeed the heat evolved in reaching a maximum temperature is inversely proportional to the amount of glycerin used in the test, as is shown in Fig. 1. Experiments with other water-miscible organic liquids such as acetone, methanol, ethanol, and ethylene glycol indicated that this effect is by no means confined to glycerin, although ethylene glycol was the only suitable substitute for glycerin.

A number of experiments were made in which the temperature rises of various mechanical mixtures of Phase I and Phase II were determined, and it was found that the hydration of each phase was almost independent of the presence of the other phase. It is evident therefore that an approximately linear rela-

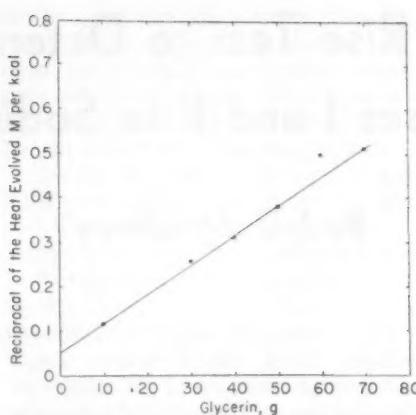


Fig. 1.—Relation Between the Heat Evolved by Hydration of Commercial Triphosphate and the Concentration of Glycerin in the Temperature Rise Test.

tion between temperature rise and Phase I content is to be expected.

#### Conductance Measurements:

Much information on the behavior of the glycerin-water-sodium triphosphate system was obtained from conductance measurements. Experiments were made in a copper beaker immersed in a constant temperature bath to minimize heating effects. The resistance between a pair of wire electrodes inserted in the mixture was measured, using a standard Wheatstone bridge circuit. Fifty grams of glycerin and 25 ml of water were pre-

mixed and thermostated at 25°C in the copper beaker. Fifteen-gram samples of the triphosphates were then added with continuous stirring and the conductance measured as a function of the time.

Some typical examples of the behavior of (1) Phase I, (2) commercial sodium triphosphate (essentially Phase II), (3)  $\text{Na}_5\text{P}_3\text{O}_{10} \cdot 6\text{H}_2\text{O}$ , and (4) Phase II prepared by dehydration of  $\text{Na}_5\text{P}_3\text{O}_{10} \cdot 6\text{H}_2\text{O}$  are shown in Fig. 2.

From curve 3 it is inferred that  $\text{Na}_5\text{P}_3\text{O}_{10} \cdot 6\text{H}_2\text{O}$  rapidly dissolves to form a solution having a rather low conductance. This, it is suggested, is the true equilibrium condition for a system containing water, glycerin, and sodium triphosphate. It is to be expected that all the mixtures will eventually come to this equilibrium.

Although it was difficult to obtain a satisfactory conductance measurement in the first minute, it was abundantly evident that Phase I material rapidly dissolved to form a solution with a high conductance and hence a high concentration. It is believed that at 1 min almost all of the initial Phase I material had dissolved and crystallization of  $\text{Na}_5\text{P}_3\text{O}_{10} \cdot 6\text{H}_2\text{O}$  was occurring rapidly (see curve 1, Fig. 2). Thus after 15 min the system had approached relatively close to the final equilibrium. It follows that almost all the heat of hydration of Phase I is released in the first few minutes. That solution of Phase I and recrystallization of  $\text{Na}_5\text{P}_3\text{O}_{10} \cdot 6\text{H}_2\text{O}$

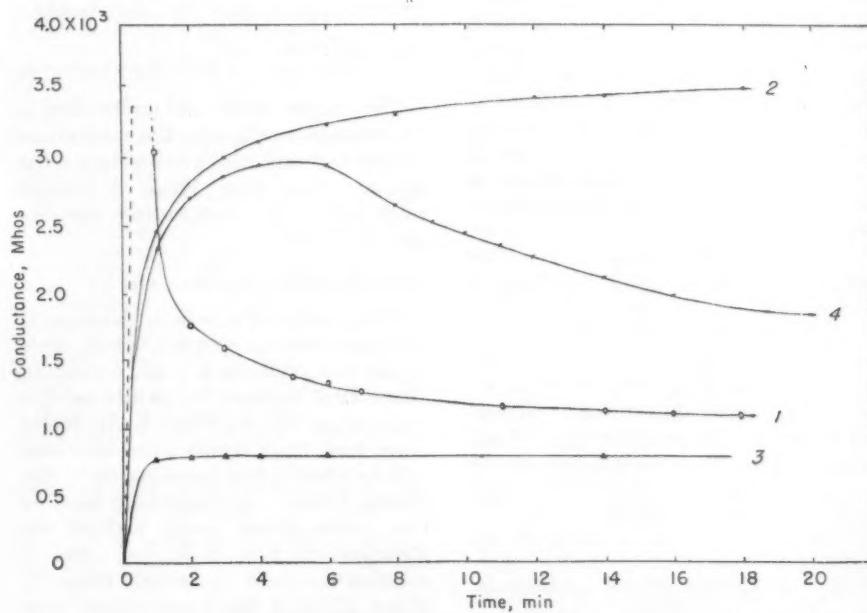


Fig. 2.—Conductance of Mixtures Containing 75 cu cm of Glycerin-Water Solution (50:25) + 15 g of  $\text{Na}_5\text{P}_3\text{O}_{10}$  as a Function of the Time from the Addition of  $\text{Na}_5\text{P}_3\text{O}_{10}$ : (1)  $\text{Na}_5\text{P}_3\text{O}_{10}\text{-I.}$ ; (2) Commercial  $\text{Na}_5\text{P}_3\text{O}_{10}$ ; (3)  $\text{Na}_5\text{P}_3\text{O}_{10} \cdot 6\text{H}_2\text{O}$  (amounts of water and  $\text{Na}_5\text{P}_3\text{O}_{10} \cdot 6\text{H}_2\text{O}$  adjusted to give the same final composition as with the other samples); (4)  $\text{Na}_5\text{P}_3\text{O}_{10}$  prepared by dehydration of  $\text{Na}_5\text{P}_3\text{O}_{10} \cdot 6\text{H}_2\text{O}$ .

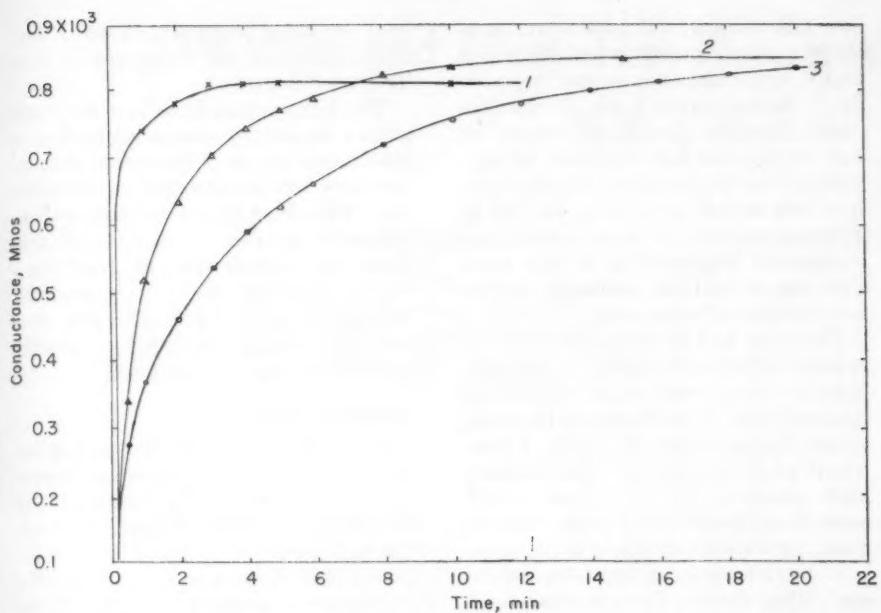


Fig. 3.—To illustrate the Relative Rates of Solution of 0.5-g Samples of (1)  $\text{Na}_5\text{P}_3\text{O}_{10}\text{-I}$ , (2)  $\text{Na}_5\text{P}_3\text{O}_{10}\text{-II}$  (from  $\text{Na}_5\text{P}_3\text{O}_{10}\cdot 6\text{H}_2\text{O}$ ), and (3) Commercial Triphosphate, in the Glycerin-Water Mixture Used in the Temperature Rise Test.

actually do occur very rapidly was confirmed microscopically.

Commercial triphosphate, which is essentially Phase II, does not dissolve so rapidly. After about 10 min the solution concentration becomes nearly constant and remains so for long periods of time although the solution is supersaturated with respect to  $\text{Na}_5\text{P}_3\text{O}_{10}\cdot 6\text{H}_2\text{O}$ .

Using smaller samples of sodium triphosphate (0.5 g) some interesting results were obtained by the conductance method. Figure 3 clearly illustrates the high rate of solution of Phase I (curve 1) in comparison with that of commercial triphosphate (curve 3). Note also that Phase II prepared by the dehydration of  $\text{Na}_5\text{P}_3\text{O}_{10}\cdot 6\text{H}_2\text{O}$  has a higher rate of solution than commercial triphosphate.

In Fig. 4 is shown the effect of adding 0.5-g samples of Phase II (prepared by dehydration) to a solution whose concentration is slowly decreasing presumably because of crystallization of the hexahydrate. It is noted that the solution concentration rises, remains constant for a definite period of time, and then slowly decreases once again.

#### Discussion:

In the light of the results of the heat of solution and conductance measurements it is suggested that the essential difference between Phase I and Phase II which permits the use of the Temperature Rise Test is the greater solubility and rate of solution of Phase I in the glycerin-water mixture. As a result, a greater number of nuclei for the crystallization of  $\text{Na}_5\text{P}_3\text{O}_{10}\cdot 6\text{H}_2\text{O}$  are formed

which is very much greater than the solubility of the hydrated form as represented by equilibrium (C). Equilibrium (B) strongly favors the formation of hydrated ions and the solution phase is greatly supersaturated with respect to  $\text{Na}_5\text{P}_3\text{O}_{10}\cdot 6\text{H}_2\text{O}$ . Although (C) is the only stable equilibrium in such a system, the attainment of this equilibrium can sometimes be very slow if only a small number of nuclei for the crystallization of  $\text{Na}_5\text{P}_3\text{O}_{10}\cdot 6\text{H}_2\text{O}$  are present. As a net result, a pseudoequilibrium is set up in which the rate of solution of anhydrous solid sodium triphosphate is equal to the rate of crystallization of solid sodium triphosphate hexahydrate. This, it is suggested, is the explanation for the horizontal portion of curve 2 in Fig. 2 and the plateaus noted in Fig. 4.

The rôle of the glycerin in the Temperature Rise Test is to decrease the solubility and rate of solution of Phase II (but not Phase I) to the point where the degree of supersaturation with respect to the hexahydrate is not very great and therefore comparatively few crystallization nuclei are formed. The crystallization of hexahydrate is the rate-controlling step in the transition from solid anhydrous Phase II to solid hexahydrate and consequently determines the rate of heat evolution of Phase II in the Temperature Rise Test. On the other hand, the solubility and the rate of solution of Phase I in the glycerin-water mixture are still great enough to provide adequate hexahydrate crystallization nuclei, and therefore the rate of heat evolution is little affected by the glycerin.

There would appear to be an anomaly in the above explanation. If Phase I provides numerous crystallization nuclei, why does the hydration of each phase apparently proceed almost in-

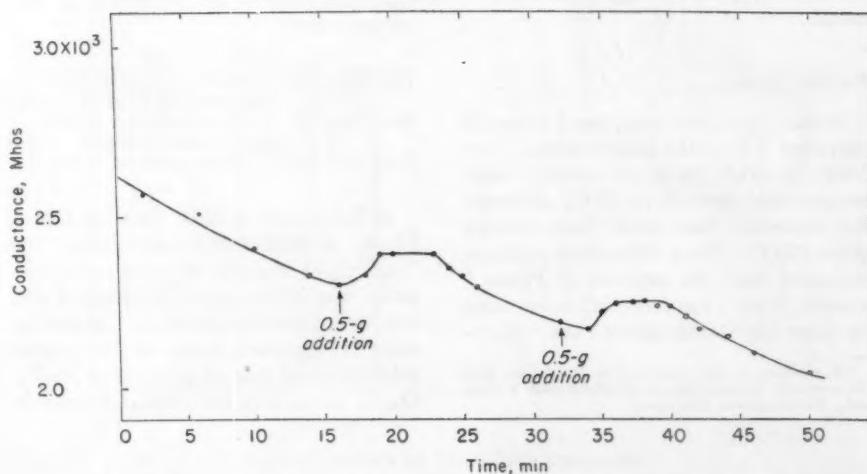


Fig. 4.—To Illustrate the Effect of Adding More  $\text{Na}_5\text{P}_3\text{O}_{10}\text{-II}$  to a Solution of  $\text{Na}_5\text{P}_3\text{O}_{10}$  in Glycerin-Water (50:25) from Which  $\text{Na}_5\text{P}_3\text{O}_{10}\cdot 6\text{H}_2\text{O}$  is Crystallizing.

dependently in mechanical mixtures? It might be expected that the presence of Phase I would, in effect, catalyze the hydration of Phase II.

A suggested explanation is that a very large number of nuclei are formed, but their ability to grow decreases very rapidly with increasing crystal size. The solution quickly becomes very supersaturated with respect to  $\text{Na}_5\text{P}_3\text{O}_{10} \cdot 6\text{H}_2\text{O}$  near the surfaces of the Phase I crystals. This results in a great many hexahydrate nuclei which grow rapidly but also at a rapidly decreasing rate. When all the Phase I has dissolved, the concentration of these highly supersaturated regions rapidly decreases as the excess of nuclei are used up. For the most part, therefore, the growth of these nuclei is at the expense of the localized high concentrations and little seeding of the main body of the solution occurs.

Although one might expect a greater amount of Phase I than of Phase II to dissolve in water, experimentally the reverse is found. Phase I apparently has the same solubility as the hexahydrate, whereas greatly supersaturated solutions (with respect to the hexahydrate) of Phase II may be prepared. As one possible explanation, Topley (9) has suggested that the rapid solution of Phase I forces crystallization of the hexahydrate in the regions immediately surrounding the dissolving Phase I crystals and hence the apparent solubility of Phase I is the same as that of the hexahydrate. This suggestion is supported by the results of the present investigation. His other possibility, that the lattice of Phase I is itself able to initiate the growth of hydrate crystals, apparently does not apply in the glycerin-water system. If the solution-recrystallization mechanism is correct for aqueous systems, perhaps with sufficiently vigorous stirring supersaturated solutions of Phase I might also be prepared.

#### Surface Area:

It was found that samples of Phase II prepared by the dehydration of  $\text{Na}_5\text{P}_3\text{O}_{10} \cdot 6\text{H}_2\text{O}$  gave abnormally high temperature rises (8 to 10 C) although the materials had never been heated above 375 C. X-ray diffraction patterns indicated that the amount of Phase I present, if any, was too small to account for these high temperature rises.<sup>4</sup> How-

<sup>4</sup> For which we are indebted to B. Topley and the research department of Albright and Wilson Ltd., Birmingham, England.

ever this material did have a comparatively low bulk density which suggested that a large surface area was responsible. Measurements made at the National Research Council in Ottawa by the low-temperature nitrogen adsorption method indicated an apparent surface area of 1.4 sq m per g for 250 to 270-mesh material, whereas a sample of commercial triphosphate in the same sieve range had an apparent surface area of only 0.25 sq m per g.

The large surface area apparently increases the rate of solution of this material in the glycerin-water mixture as demonstrated by conductance measurements (compare curve 2, Fig. 3). Therefore it might be expected that localized high solution concentrations might occur more frequently, thereby forming nuclei for the crystallization of the hexahydrate and increasing the temperature rise. That the rate of crystallization of hexahydrate using the dehydrated material is greater than for commercial triphosphate is inferred from the shape of the conductance curve in Fig. 2 (curve 4). The "pseudoequilibrium plateau" is very brief, and beyond it the solution concentration begins to decrease. Presumably the same effect would be noted with commercial triphosphate after a much longer period of time.

It seems rather improbable that high temperature rises due to large surface areas are likely to occur commercially. However, it is noteworthy that samples of granular sodium triphosphate generally have a slightly lower temperature rise, and this may probably be ascribed to their low surface area.

#### Summary:

The heats of solution of  $\text{Na}_5\text{P}_3\text{O}_{10} \cdot \text{I}$ ,  $\text{Na}_5\text{P}_3\text{O}_{10} \cdot \text{II}$ , and  $\text{Na}_5\text{P}_3\text{O}_{10} \cdot 6\text{H}_2\text{O}$  in dilute (1 to 3 per cent by weight) and concentrated aqueous solutions (25 to 30 per cent by weight) were determined. The results obtained expressed as kcal per mole are:

$\text{Na}_5\text{P}_3\text{O}_{10} \cdot \text{I}$	dilute solution	-16.1
	concentrated solution	-18.5
$\text{Na}_5\text{P}_3\text{O}_{10} \cdot \text{II}$	dilute solution	-14.0
	concentrated solution	-16.9
$\text{Na}_5\text{P}_3\text{O}_{10} \cdot 6\text{H}_2\text{O}$	dilute solution	+2.6

A Temperature Rise Test used as a plant method for determining the  $\text{Na}_5\text{P}_3\text{O}_{10} \cdot \text{I}$  content of commercial material was investigated by thermal and conductance measurements. A mechanism is suggested, based on the greater solubility and rate of solution of  $\text{Na}_5\text{P}_3\text{O}_{10} \cdot \text{I}$ , to explain the great difference in

heat evolution between Phase I and Phase II under the Temperature Rise Test conditions.

The Temperature Rise Test evidently gives a reasonably reliable estimation of the Phase I content. Increasing the surface area will increase the temperature rise. This effect was particularly noticeable with samples of  $\text{Na}_5\text{P}_3\text{O}_{10} \cdot \text{II}$  prepared by dehydration of  $\text{Na}_5\text{P}_3\text{O}_{10} \cdot 6\text{H}_2\text{O}$ . However, in most commercial samples the surface area probably does not vary enough to influence greatly temperature rise measurements.

#### Acknowledgment:

The author wishes to express his indebtedness to A. E. R. Westman, Director, Department of Chemistry of the Ontario Research Foundation, for his advice and direction in this study and to the Electric Reduction Co. of Canada, Ltd. for permission to publish the results of the investigation.

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# An Improved Heat Test Apparatus for Tung Oil

By F. C. Pack<sup>1</sup>

## SYNOPSIS

The construction of an improved oil bath of rugged and dependable design for the Browne Heat Test is described. The bath embodies adequate heat capacity, insulation, electrical heating, mechanical agitation, and precise automatic temperature control. The improved bath allows the gelation time of tung oil samples to be checked with good precision.

ONE of the most informative and unequivocal characteristics of tung oil subject to easy measurement is time of gelation at elevated temperatures. Although another characteristic, refraction of light (refractive index and refractive dispersion), which is an indication of the probable source of the tung oil (foreign or domestic) and the degree of adulteration, if any, can also be easily measured, in most cases gel time is sufficient to fulfill the requirements of tung oil users in the coatings industry.

The commonly used heat test for tung oil (the Browne test<sup>2</sup> as described for official use<sup>3</sup> with current revisions<sup>4</sup>) employs simple equipment available in most laboratories. In the Browne test, the oil bath is heated to 293.0°C, sample tubes containing 5.0 ml of tung oil are immersed in the bath, and the temperature is allowed to fall to 282.0°C. The bath is then held at the desired temperature by manipulating a gas burner. To maintain the desired oil bath temperature with this equipment is, however, exceedingly difficult unless some insulation is used.

Uniform bath temperature is unlikely without mechanical agitation, and the maintenance of constant bath temperature by manual adjustment of a gas burner requires continuous attention. Moreover, the vegetable oil used in the bath smokes badly at the requisite temperature and becomes viscous and darkened after short use.

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<sup>1</sup> Southern Regional Research Laboratory, New Orleans, La. One of the laboratories of the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U. S. Department of Agriculture.

<sup>2</sup> F. Browne, *Chemical News*, Vol. 108, pp. 14-15 (1912); *Chemical Abstracts*, Vol. 7, p. 2315 (1913).

<sup>3</sup> Henry A. Gardner and G. G. Sward, "Physical and Chemical Examination of Paints, Varnishes, Lacquers, and Colors," Eleventh Edition, pp. 426-427 (1950).

<sup>4</sup> Standard Specification for Raw Tung Oil (D 12 - 48), 1952 Book of ASTM Standards, Part 4, p. 211.

lubricating oil (Navy Symbol 5190) proved to be particularly suitable for the bath. Its viscosity is not excessive at room temperature, and stirring of the bath can be started at the time the heaters are turned on. This obviates overheating in the vicinity of the heating elements during the "warm-up" period. Losses resulting from the volatility of some low-boiling fractions are not excessive in the equipment as redesigned.

## APPARATUS

The redesigned apparatus is illustrated in Fig. 1. The oil bath is a 4-liter stainless steel beaker, *B*, supported concentrically within a 3-gal earthenware crock, *E*. The intervening space is lagged with rock wool, *J*.

The top of both the beaker and the crock is covered with a sheet of mate-

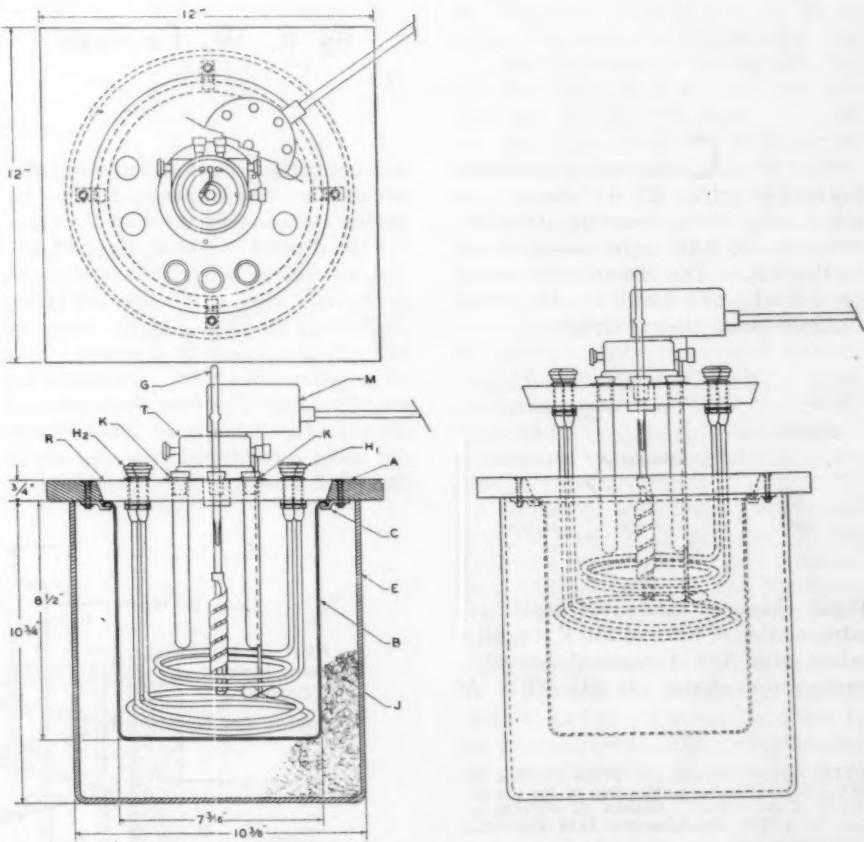


Fig. 1.—Browne Heat Test Apparatus.

*A* = transite cover 12 by 12 by  $\frac{3}{4}$  in. thick; *B* = 4-liter stainless beaker; *C* = support clip for beaker; *E* = earthenware crock; *H*<sub>1</sub> = 500-w heater; *H*<sub>2</sub> = 1000-w heater; *M* = motor stirrer; *T* = thermoregulator; *R* = removable center section of cover; *G* = thermometer; *J* = insulation; *K* = hole for 16 mm test tube.

rial similar to "Transite."<sup>5</sup> The cover supports the beaker within the crock and holds the heating and control equipment.

To simplify assembly of the bath components, it is convenient to divide the top into two sections: a central, removal section, *R*, which covers the stainless steel beaker and holds the heating and control equipment, and an outer peripheral section, *A*, which supports the beaker and maintains its concentric position within the earthenware crock by means of clips, *C*.

The bath is heated by two immersion-type heaters coiled within the beaker. One 1000-w unit, *H*<sub>2</sub>, is used only to bring the bath up to operating temperature and is controlled manually. One 500-w unit, *H*<sub>1</sub>, wired through the

<sup>5</sup> Mention of the name of the manufacturer does not constitute endorsement of such equipment by the U. S. Department of Agriculture over similar equipment not mentioned.

control equipment is used to maintain constant temperature.

The control equipment is composed of a bimetal thermoregulator, *T* (this type of regulator was settled upon after many trials with other types) and a mercury tube relay (not shown). This bimetal regulator must be modified slightly to perform satisfactorily at the operating temperature, which is somewhat above the range for which the instrument is designed. At the high temperature required, the set screws located on the collar projecting from the under side of the base plate fail to hold, but this may be remedied by countersinking at the points of contact of the screws.

The materials and equipment required to construct the bath are listed below:

- One 4-liter stainless steel beaker.
- One 3-gal earthenware crock.

One sheet "Transite," hard asbestos board, or similar material 12 by 12 by  $\frac{3}{4}$  in.

One motor-driven stirrer (continuous-duty type).

One 500-w immersion heater (Am. Inst. Co. "Lo Lag" type).<sup>5</sup>

One 1000-w immersion heater (Am. Inst. Co. "Lo Lag" type).<sup>5</sup>

One constant temperature assembly (Am. Inst. Co. Catalog No. 4-11A with high range bimetal thermoregulator).<sup>6</sup>

One thermometer (High Range 10 C in ASTM Specification E 1 - 52).<sup>6</sup>

One gallon mineral Marine-Engine and Cylinder Oil (Navy Symbol 5190).

The heat test, using the improved apparatus, is made simply by inserting the sample tubes into the hot oil bath and noting the time required for gelation of the tung oil to take place.

<sup>6</sup> Standard Specifications for ASTM Thermometers (E 1 - 52), 1952 Book of ASTM Standards, Parts 3, p. 1503; 4, p. 1025; 5, p. 1139.

## Measurements of Motor Oil Viscosity at 0 F

By R. W. Foreman<sup>1</sup>

**C**ONSIDERABLE emphasis has been placed on the 0 F viscosity of motor oils by the recently (October, 1950) revised SAE crankcase-oil classification (1).<sup>2</sup> The classification specifies 0 F viscosity limits for 5W, 10W, and 20W motor oils as follows:

Classification	0 F Viscosity Range (SUS)	
	Minimum	Maximum
5W.....	.....	4 000
10W.....	6 000	12 000
20W.....	12 000	48 000

These viscosity values are based on extrapolation of 100 and 210 F viscosity values using ASTM standard viscosity-temperature charts (D 341-43).<sup>3</sup> A

number of investigators have reported anomalous viscosity-temperature behavior at temperatures near or below the cloud point of motor oils (2,3,5,6,8). The anomalous behavior was observed in capillary viscometers and has generally been in the form of higher measured viscosity (or apparent viscosity) than temperature-viscosity extrapolation would predict. However, measurements made in this laboratory several years ago using a rotational type viscometer showed low-temperature viscosities to

deviate both positively and negatively from extrapolated values. The present study was undertaken to explore these observations more thoroughly and provide accurate data for three current types of blended motor oils.

### APPARATUS

#### Temperature Bath:

A diagrammatic sketch of the closely regulated 0 F bath used in this work is shown in Fig. 1. The bath was filled

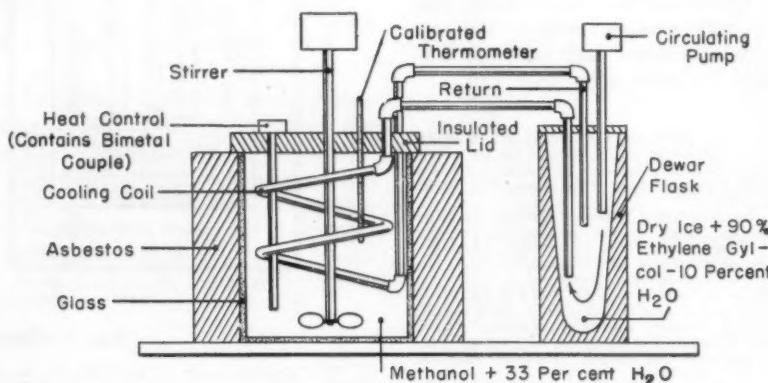


Fig. 1.—0 F Viscosity Bath.

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<sup>2</sup> The boldface numbers in parentheses refer to the list of references appended to this paper.

<sup>3</sup> Standard Viscosity-Temperature Charts for Liquid Petroleum Products (D 341-43), 1952 Book of ASTM Standards, Part 5, p. 167.

with absolute methanol-water solution (67 per cent methanol) while the external refrigerating unit was maintained at -40 to -60 F by adding crushed dry ice to a 10 per cent water - 90 per cent ethylene glycol solution. Temperature was maintained at  $0 \pm 0.2$  F by an immersion heater controlled by a sensitive bimetallic couple. This temperature control was somewhat outside ASTM limits ( $\pm 0.1$  F), but the method of taking many random readings compensated for this. The heater compensated for the continuous cooling of the refrigerant pumped through immersed copper coils in the bath. An ASTM 33C (Erco) certified and calibrated 51-mm immersion thermometer having a -38 to +42 C range and graduated in 0.2 C was used for measurement of 0 F (-17.78 C). This thermometer was chosen because it was the only calibrated, sensitive thermometer useful at 0 F available at the time these experiments were conducted.

#### Viscometers:

Two types of viscometers were employed in this work, rotational and capillary. Figure 2 is a photograph of the rotational type—a Stormer viscometer, equipped with an accurately dimensioned cylindrical brass cup and aluminum bob. The instrument base was altered to permit immersion of the cup and bob in the 0 F temperature bath. As can be seen in Fig. 2, the bob is vertically grooved and the cup contains a close fitting stainless steel screen. These features greatly minimized slippage at the liquid contact surfaces.

The capillary viscometers used in this work are of standard Ubbelohde design (see ASTM D 445-52 T).<sup>4</sup> A series 4 tube having approximately a 3.5-mm capillary diameter and a series 5 tube with a 6.3-mm capillary diameter were employed.

#### EXPERIMENTAL PROCEDURE

##### Calibration:

Calculations of viscosity and shear rate were made from instrument dimensions plus measurement data. This obviated the use of calibrating viscosity standards which are not readily available in the lube oil range for 0 F. The measurement data required for calculation of viscosity are rate of revolution of the bob and total weight on the pulley. The equation for calculating viscosity is as follows:

$$\eta_0 = 0.01754 \frac{G}{B} \dots \dots \dots (1)$$

<sup>4</sup> Tentative Method of Test for Kinematic Viscosity (D 445-52 T), 1952 Book of ASTM Standards, Part 5, p. 187.

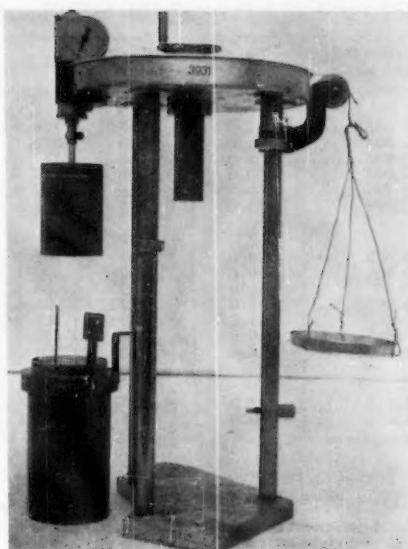


Fig. 2.—Stormer Viscometer.

where:

$\eta_0$  = absolute viscosity (poise),  
 $G$  = weight on pulley (grams), and  
 $B$  = angular velocity of bob, rps.

The numerical value 0.01754 was determined by substitution of instrument dimensions and conversion factors in the general equation for rotational viscometers (9):

$$\eta_0 = \frac{T}{D} \frac{R_B^{1/2} - R_C^{1/2}}{4\pi h} \dots \dots \dots (2)$$

where:

$T$  = torque on bob (131.9G for this instrument),  
 $D$  = angular velocity of bob rotation in radians per sec ( $2\pi B$ ),  
 $h$  = height of bob (cm), and  
 $R_C$  and  $R_B$  = radii of cup and bob (cm) measured from axis of rotation to screen surface and bob periphery, respectively.

The cup and bob dimensions were measured at 0 F. The peripheral diameter of the bob was 4.196 cm while the inside diameter of the cup (including the screen) was 4.984 cm.

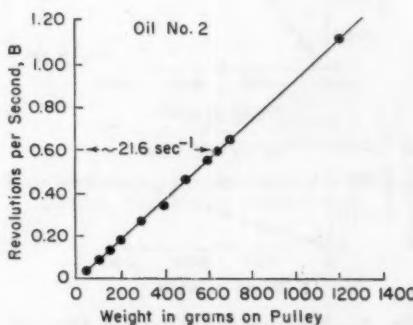


Fig. 3.—Typical Pulley Weight Plot Obtained from Rotational Viscometer at 0 F and Calculations Based on Plot.

The reliability of the foregoing equation could not be verified at 0 F for lack of suitable standards. However, evidence for reliability of the Stormer in providing independent viscosity values from instrument dimensions is shown by the following results on two lube oils measured at 100 F by both a Ubbelohde viscometer and the Stormer. Dimensional constants of the Stormer were measured at 100 F to provide an equation differing only slightly from Eq 1.

Sample	Ubbelohde Viscosity, centipoises	Stormer Viscosity, centipoises
Solvent-extracted bright stock . . .	472	479
Solvent-extracted SAE 30 oil . . .	83.5	84.6

As is noted, the values show agreement within 2 per cent, with the Stormer values slightly higher than the Ubbelohde values.

Ubbelohde viscometers used in this work were calibrated at 100 F using NBS viscosity oil standards according to ASTM Tentative Method D 445.

#### Procedure:

Measurements with the Stormer instrument were made as follows: Sufficient oil to reach the top surface of the bob was transferred to the cup with the bob in position, and the cup and bob immersed in the 0 F bath. The oil was cooled for a minimum of 20 min at 0 F and oil added occasionally to correct for contraction. The pulley was loaded with a heavy weight (500 g) and the oil sheared for a period of about 5 min to assure uniform temperature distribution and thorough agitation. Randomly selected weights were then attached to the pulley and observations of time required for a convenient number of revolutions (range of  $\frac{1}{4}$  to 100 in this work) recorded for each weight. The random selection of weights essentially eliminated systematic error.

Calculation of viscosity was made using the equation given above. Figure 3 shows a typical plot of data obtained for a blended motor oil and illustrates how viscosity was calculated from the data.

Kinematic viscosity was determined by the procedure outlined in ASTM Method D 445. The only addition to the procedure was prolonged precooling (24 hr minimum) of oil samples at about 35 F. This was done to avoid effects due to shock cooling such as described by S. G. Daniel (3). The oil samples were transferred rapidly to Ubbelohde tubes just prior to insertion in the 0 F bath. Thirty minutes were allowed for 0 F temperature equilibrium

TABLE I.—INSPECTION DATA OF ALL OILS<sup>a</sup> USED IN 0 F VISCOSITY STUDY.

Oil Number	Grade	Cloud Point, 0 F	Density at 0 F, g per ml <sup>b</sup>	$V_{210}$ F., SUS	$V_{100}$ F., SUS	V.I.
<b>Type A<sup>c</sup></b>						
1.....	SAE 10W	...	0.895	51.0	233	120.9
2.....	SAE 10W	...	0.894	51.0	229	122.9
3.....	SAE 10W	...	0.896	52.2	264	113.0
4.....	SAE 10W	-2	0.906	50.0	222	119.5
5.....	SAE 10W	...	0.894	50.0	218	122.0
6.....	SAE 20W	-2	0.898	72.0	517	119.8
<b>Type B<sup>c</sup></b>						
7.....	SAE 20W	...	0.900	59.0	401	101.9
8.....	SAE 20W	+6	0.900	59.0	409	99.6
9.....	SAE 20W	...	0.901	59.0	412	98.5
10.....	SAE 20W	+4	0.900	57.3	398	95.0
11.....	SAE 10W	...	0.892	45.5	180	103.2
12.....	SAE 10W	-4	0.895	46.0	188	102.9
13.....	SAE 10W	...	0.893	46.6	190	108.9
<b>Type C<sup>c</sup></b>						
14.....	CRN 10	+22	0.914	42.0	150	64.5
15.....	CRN 20	+18	0.924	50.0	305	69.7

<sup>a</sup> ASTM pour points all below -20 F.<sup>b</sup> Determined by ASTM Standard (D 287 - 52) Method of Test for Gravity of Petroleum and Its Products by Hydrometer, 1952 Book of ASTM Standards, Part 5, p. 149, and extrapolation using Tables I and II of the Tag Manual.<sup>c</sup> Type A oil—a detergent oil blend of solvent refined, mid-continent base oils and containing viscosity index (V.I.) improver and pour point depressant; type B oil—nondetergent inhibited oil, otherwise similar to type A; type C oil—uninhibited, conventionally refined, mid-continent neutral oil with pour point depressant.

to be reached. Samples were protected against moisture condensation by use of drying tubes.

#### Samples:

Three types of finished commercial motor oils all having ASTM pour points below -20 F were employed in this study. Type A was a detergent oil blended from solvent refined, mid-continent base oils and containing an improver for viscosity index (V.I.) and a pour point depressant. Type B was a nondetergent but inhibited oil similar to type A in other respects. It contained much less V.I. improver. Type C was an uninhibited, conventionally refined, mid-continent neutral containing a pour point depressant. A total of 15 oils was studied. Inspection

data consisting of cloud point, density, viscosity at higher temperatures, and V.I. are shown in Table I for these 15 oils.

#### RESULTS

Typical graphs of experimental rotational viscometer data are shown for each of the three types of oils in Figs. 4, 5, and 6. The rate of revolution plotted on the ordinate in these graphs is directly proportional to rate of shear, while the abscissa (pulley weight) is directly proportional to shear stress. It is noteworthy, then, that these oils all displayed Newtonian liquid behavior at 0 F (linear shear rate-shear stress plot with the line passing through the origin). The shear rate range covered

was approximately 2 to 60 sec<sup>-1</sup>. The linearity of the plots likewise attests to satisfactory experimental technique since bath temperature fluctuations, insufficient sample cooling, or sporadic instrument and operator error would cause a greater scattering of points about the lines. Although no data on repeatability are presented, several of these oils were remeasured at later dates and viscosity agreement within 1 per cent obtained.

Complete 0 F viscosity data for all 15 oils calculated from such plots appear in Table II. These tables contain 0 F viscosities extrapolated from data in Table I using ASTM viscosity temperature charts D 341, rotational viscosities measured at 0 F, and Ubbelohde viscosities measured at 0 F. Comparison of the data is facilitated by the inclusion of measured to extrapolated viscosity ratios.

From data in Table II, it is observed that rotational viscosities either approximate or are less than extrapolated viscosities. This discrepancy is as much as 30 per cent in some cases. Ubbelohde viscosities either approximate or are considerably greater than extrapolated viscosities.

#### Discussion of Results:

Explanation for the high ratio of Ubbelohde  $V_0$  to extrapolated  $V_0$  probably lies in the existence of a second phase in the oil. This is qualitatively supported by comparing the magnitude of the above ratio to cloud point as shown in Fig. 7. The highest ratios are observed for oils having cloud points above 0 F. This agrees in general with results reported previously in the literature (3,5). Considerable difficulty in

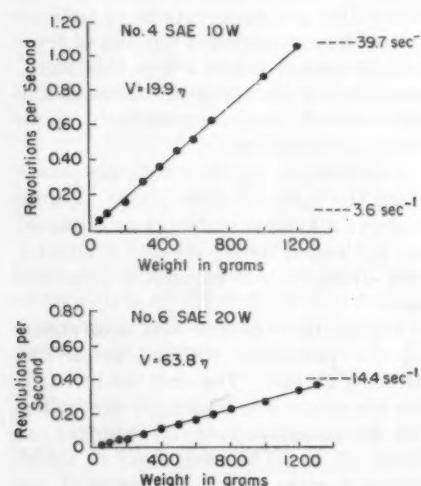


Fig. 4.—Experimental Viscosity Plots of Type A Motor Oils (Solvent Extracted Base Oils) as Obtained from Rotational Viscometer Measurements at 0 F.

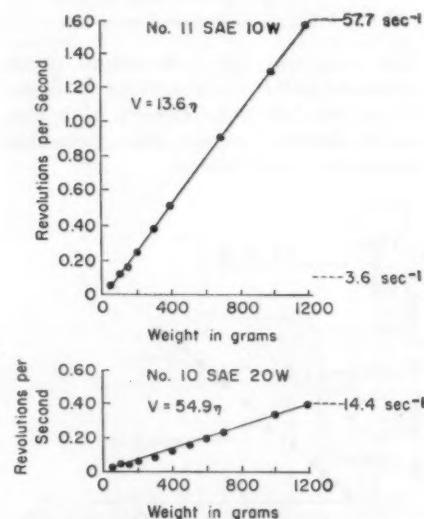


Fig. 5.—Experimental Viscosity Plots of Type B Motor Oils (Solvent Extracted Base Oils) as Obtained from Rotational Viscometer Measurements at 0 F.

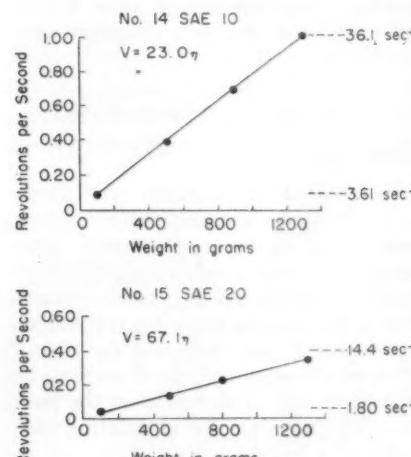


Fig. 6.—Experimental Viscosity Plots of Type C Motor Oils (Conventionally Refined Base Oils) as Obtained from Rotational Viscometer Measurements at 0 F.

TABLE II.—0 F VISCOSITY DATA (SUS) ON MOTOR OILS.<sup>a</sup>

Oil Number	Extrapolated $V_0$	Rotational $V_0$	Kinematic $V_0$	Rotational $V_0$ Extrapolated $V_0$	Kinematic $V_0$ Extrapolated $V_0$
<b>Type A</b>					
1.....	11 500 ( $\pm 500$ )	10 100	13 400	0.88	1.17
2.....	10 500 ( $\pm 500$ )	9 800	11 600	0.935	1.11
3.....	15 500 ( $\pm 500$ )	13 500	22 500–26 800	0.87	1.59 (avg)
4.....	10 500 ( $\pm 500$ )	10 100	12 500	0.96	1.24
5.....	9 500 ( $\pm 500$ )	8 500	11 400	0.895	1.20
6.....	33 000 ( $\pm 2000$ )	32 600	46 100	0.99	1.40
<b>Type B</b>					
7.....	37 000 ( $\pm 2000$ )	30 400	51 700	0.82	1.70
8.....	38 000 ( $\pm 2000$ )	34 100	90 000–134 000	0.895	2.42 (avg)
9.....	38 000 ( $\pm 2000$ )	31 300	55 900	0.825	1.47
10.....	40 000 ( $\pm 2000$ )	28 000	45 000–53 100	0.70	1.20 (avg)
11.....	10 000 ( $\pm 500$ )	7 000	9 600	0.70	0.96
12.....	10 500 ( $\pm 500$ )	7 200	10 800	0.685	1.03
13.....	10 000 ( $\pm 500$ )	8 600	11 200	0.86	1.12
<b>Type C</b>					
14.....	10 000 ( $\pm 500$ )	11 500	22 900	1.15	2.29
15.....	40 000 ( $\pm 2000$ )	33 300	61 000	0.82	1.53

<sup>a</sup> Type A oil—a detergent oil blend of solvent refined, mid-continent base oils and containing viscosity index (V.I.) improver and pour point depressant; type B oil—nondetergent inhibited oil, otherwise similar to type A; type C—uninhibited, conventionally refined, mid-continent neutral oil with pour point depressant.

achieving repeatability was encountered for oils having high Ubbelohde  $V_0$  to extrapolated  $V_0$ .

Explanation for the low ratio of rotational  $V_0$  to extrapolated  $V_0$  for many oils is less certain. The low ratios were apparently not due to instrument calibration error since the ratios show no uniformity of values. The linearity of plots in Figs. 4, 5, and 6 rules out operational errors. A possible explanation is that the ASTM viscosity-temperature chart (D 341) does not apply correctly at low temperatures for solvent refined oils containing V.I. improvers. Even conventionally refined oils containing pour point depressants may be included here, although data are too limited to provide more than an indication (see Table II, sample No. 15). This explanation implies that the true viscosity is measured in the rotational viscometer, whereas extrapolated and measured capillary values are in error. Some support for this explanation can be found in the literature. Viscosity-temperature data for many lubricating fluids, including several types of synthetic oils, are presented on ASTM viscosity-temperature charts by Murphy, et al. (4). Their data show considerable deviations from linearity for many of the fluids. Present-day petroleum base oils contain synthetic fluids in the form of V.I. improvers, inhibitors, and pour point depressants which might be responsible in part for the results reported here.

The rotational viscometer, contrasted to the capillary type, is much less sensi-

tive to small amounts of a second phase. A relatively narrow range of shear rates is applied to the liquid which is constantly sheared during measurement. This accounts for the Newtonian behavior of the oils in the rotational viscometer, while the capillary viscometer indicates non-Newtonian behavior. The movement of parts in a starting engine is more analogous to a rotational viscometer than to the capillary type. Since low-temperature viscosity is a major governing factor in cold weather engine starting, it would appear that specification of such viscosities based on rotational viscometer measurements would better insure the desired performance.

#### SUMMARY

It has been shown by measurements on several oils that repeatable 0 F viscosities can be obtained for blended

motor oils rapidly and simply, using a rotational viscometer. Capillary viscometers gave high and erratic results and were considered unsuitable. Comparison of rotational viscometer viscosities with extrapolated viscosities disclosed the former to be generally, though not uniformly, lower than the latter. It is suggested that the rotational viscosities determined at 0 F describe better the lower temperature performance of the oil than do extrapolated viscosities now required by SAE specifications.

#### Acknowledgment:

The author is indebted to David Frazier for his assistance in designing and directing the use of the rotational viscometer, to E. C. Hughes and F. J. Sanders for suggesting the problem and ideas on attack, and to Miss J. A. Geesey for making experimental measurements.

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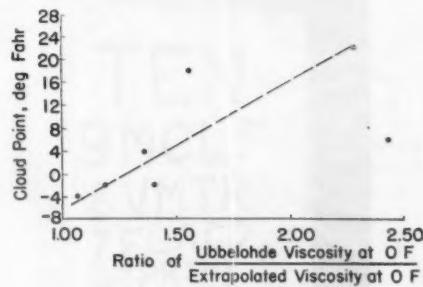


Fig. 7.—Relationship of Measured Ubbelohde Viscosity to Cloud Point.

# The Kerr Definometer: An Instrument Designed to Evaluate the Sharpness of Image Gloss of Decorative Wallboard

By W. Raymond Kerr<sup>1</sup>

## SYNOPSIS

An instrument has been devised to measure the image definition of glossy finishes on such material as decorative wallboard. This evaluation is made by measuring the sharpness of image gloss of the surface in terms of a standard graduated chart used to produce a reflected image under definite conditions.

The instrument is simple to construct and operate. Close checks on identical material are possible between observers. The use of the instrument is not limited to decorative wallboard; it may be used for other glossy industrial finishes.

THE appearance of the product made under the generic name of decorative wallboard depends upon a number of factors. Among these are type of hard board base used, type of finish, number of coats, and method of processing. In judging the appearance of such materials, the customer usually is impressed by a finish that has some "depth" and that is smooth visually as well as to the touch. The degree of sharpness with which reflected objects can be viewed in such finishes is one measure of the appearance of the product. This property of reflection may be termed "image definition," and it is with this term that the author deals.

Image definition, or distinctness of image, or sharpness of image, are like terms that describe that attribute of an industrial finish which enables it to reflect images in a manner similar to a mirror. Image definition varies among different types of decorative wallboard. It is of value in comparing various finishes on hard-pressed fiberboard because it is an integrated measure of the smoothness of the film, the degree of effectiveness of sanding, the fiber surface characteristics of the hardboard material, the degree of "delustering" of the film, any tendency of base films to "wrinkle," and the final topcoat application. Sharpness of image gloss is covered in the literature. Methods have been developed by the Detroit Paint and Varnish Production Club<sup>2</sup> and by Sward and Levy<sup>3</sup> for its measurement. Hun-

ter<sup>4</sup> outlined a method based on reflected images of a target pattern and just recently the same author has rather fully discussed the subject of gloss in the December, 1952, issue of the ASTM BULLETIN.<sup>5</sup>

It was thought that image definition in terms of a related series of objects of varying size might be a more nearly precise method of evaluation. To this end, an instrument was conceived and constructed as described in this article. It is shown in external detail in Figs. 1 and 2.

<sup>4</sup> R. S. Hunter, "Gloss Investigation Using Reflected Images of a Target Pattern," *Journal of Research, Nat. Bureau Standards*, Vol. 16, p. 359 (1936), (RP879).

<sup>5</sup> R. S. Hunter, "Gloss Evaluation of Materials," *ASTM BULLETIN*, No. 186, December, 1952, p. 48.

## FACTORS INFLUENCING IMAGE DEFINITION

Several factors influencing image definition have already been mentioned. There are other factors that must be considered in the construction of an instrument to measure image definition. Distance is important; the greater the object distance, the less distinct is the image.

Another important factor is the angle at which the image is viewed, as shown in Fig. 3. As indicated, the most desirable way to evaluate image definition is by viewing the object reflected at an acute angle. However, there is a workable tolerance limit to the viewing angle that has been found satisfactory within a range of from 0 to about 25 deg. The instrument has been designed and distances of viewing so established that viewing of the image may be carried out within this 25-deg angle as shown in Fig. 4.

Sharpness of outline of the object viewed is important. This seems axiomatic. It was found that sharply drawn black outlines against a bright background would serve very satisfactorily. This combination of black against white was decided to be better than a combination of white on black made by cutting various size letters in thick stencil paper and illuminating



Fig. 1.—Definometer Assembly with Chart Mounted "Backwards." Flood-Type Reflector Lamp Is Also Shown.

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<sup>1</sup> Armstrong Cork Co., Beaver Falls, Pa.  
<sup>2</sup> Detroit Paint and Varnish Production Club, "Standard Method of Gloss Measurement," National Paint, Varnish, & Lacquer Assn., *Scientific Section Circular 432* (1932).

<sup>3</sup> Sward and Levy, "A Simple Device for Measuring Gloss," National Paint Varnish and Lacquer Assn., *Scientific Section Circular 380* (1931).

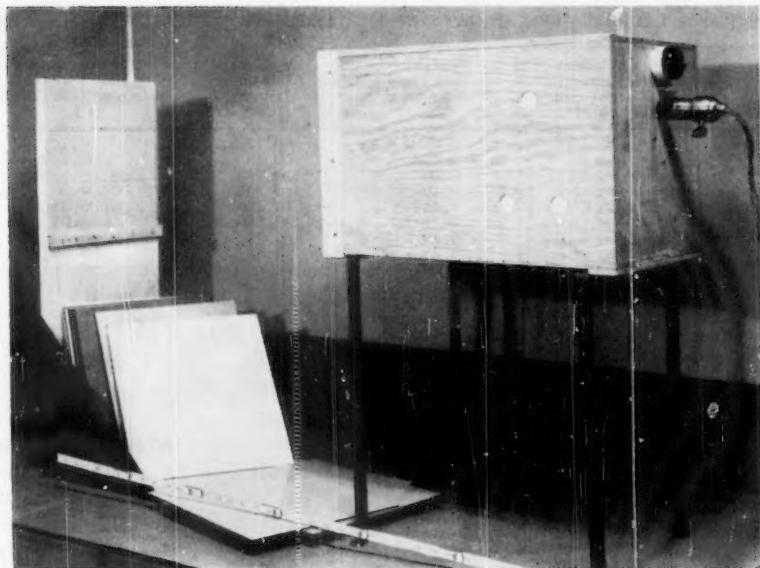


Fig. 2.—View Showing Definometer on Legs and Simple Arrangement for Holding the Specimen in Viewing Position.

from behind, thereby producing a bright outline of the letter against a black background in a darkened room. Black outlines against a bright background have a further distinct advantage in that slight surface imperfections in the finished wallboard show up in the comparison. If a black background is used, surface defects such as blemishes, uneven paint films, and waviness are not noticeable. It is important that such defects be apparent during examination as this aids in the over-all evaluation.

Degree of contrast between the black object and the white background is important. After trying various combinations, it was found that solid black letters inked with India drawing ink on both sides of good quality tracing cloth, and illuminated from behind, gave excellent contrast. It was, therefore, decided to use this combination with various sizes of letters as the object chart.

The intensity of illumination was also explored empirically and found to have

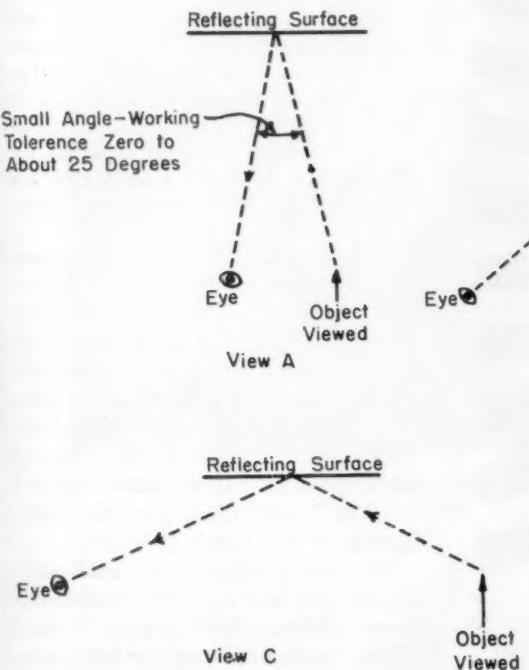


Fig. 3.—Several Angles of Viewing. The Angle Shown in View A is Recommended for This Method.

wide tolerance. Various lamps were tried and the same definition values were noted with lamps delivering 22, 175, 200, and 340 foot candles. The source of illumination selected was a reflector flood-type 150 w, 120-v incandescent lamp which diffuses the light rather evenly over the chart.

Another factor checked empirically was whether or not the image definition should be determined in a lighted or darkened room. Under both circumstances, the same results were obtained, but it appears that the value can be decided more quickly when overhead lights are not a factor and when glare from unshaded windows is eliminated. Therefore, the instrument should be installed under conditions where it can be operated in a darkened room or where a curtain shield may be drawn around the assembly to avoid overhead light effects and window glare.

Different colors of otherwise identical finish on hardboard have been checked for image definition, and it appears that differences due solely to color are not noticeable to any extent. Some colors have been noted in which the image definition values are higher or lower than for other colors, but the differences are small for materials processed identically except for the color of the final coat. It is very possible that differences are due more to slight formulation changes or to pigmentation than to the color.

Image definition of some wallboard changes if the test piece is turned 90 deg while being kept parallel to the objective chart. The variation is about one unit or less when it occurs. It is believed to be due to slight variations of gun pattern when the finish is sprayed. In cases where this small variation in image

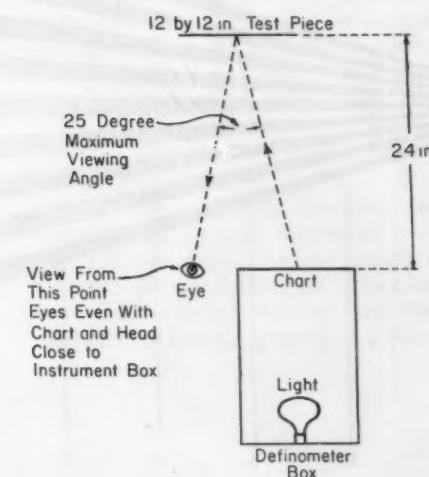


Fig. 4.—Viewing Angle for Determining Image Definition.

definition exists, the average of the two determinations should be reported.

#### VARIOUS PATTERNS OF OBJECTIVE CHART TRIED

The most obvious objective chart is a graduated series of letters one line above another. Several designs were tried, and it was agreed among five observers that square block letters of varying size were better than letters that were relatively higher than their width. The square form was the style adopted.

Another idea tried was that of using a single block letter M as an object chart of black letter on white background illuminated from behind. The M was moved a certain distance from the reflecting surface until the image became blurred and then advanced to the distance at which the image became clear. While this method might be used with some modification, there was not close agreement among observers on the exact distance at which the image is clear. This idea was dropped in favor of the graduated series of letters viewed from a fixed distance.

A graduated series of vertical parallel lines of varying height, thickness, and spacing between lines was also tried. This eliminates the need for reading any letters or characters, but observers all agreed that this type chart was less satisfactory than the lettered chart.

A chart, similar to a portion of the test pattern used in television, was also

TABLE I.—SPECIFICATIONS FOR LETTERS ON CHART.

Line Number or Value	Dimensions of Letters (Height and Width), in.	Width of Line Used in Letters, in.	Spacing Between Letters, in.	Spacing Between Line and Next Larger Line Above, in.
1 .....	1/8 by 1/8	0.0325	0.125	0.1
2 .....	1/4 by 1/4	0.055	0.15	0.1
3 .....	3/8 by 3/8	0.08	0.175	0.15
4 .....	1/2 by 1/2	0.10	0.20	0.20
5 .....	5/8 by 5/8	0.125	0.225	0.22
6 .....	2/4 by 2/4	0.15	0.250	0.25
7 .....	1.0 by 1.0	0.19	0.30	0.30
8 .....	1 1/4 by 1 1/4	0.25	0.35	0.35
9 .....	1 1/2 by 1 1/2	0.28	0.4	0.4
10 .....	2.0 by 2.0	0.375	0.5	..

designed, and is shown in Fig. 5. It was constructed on about the same ratio of line width and spacing used in the lettered objective charts. It was thought that by viewing the image of this chart at a fixed distance, a point could be found on the chart where the lines would separate clearly; and thus, by dividing the chart into ten separate steps, it would be possible to use it for evaluating image definition. When compared with the lettered chart it was possible to obtain fairly close evaluations by the use of either chart, but seven observers agreed that the lettered chart was quicker to use and offered less possibility of confusion.

#### FINAL DESIGN AND CONSTRUCTION OF THE DEFINOMETER

The instrument is quite simple, consisting basically of a boxed source of light shining against a chart at one end

of the box. The chart image is reflected from the specimen surface which the observer views from a fixed distance and at an angle of somewhat less than 25 deg. By deciding which graduated lines can be seen clearly, in contradistinction to those which are hazy, a numerical value ranging from 1 to 10 can be assigned. Values higher than 10 were not considered worth while since anything in that range is very poor with respect to image definition. Figures 6 and 7 show the appearance of the chart on two separate finishes, one of which is markedly better than the other.

The box is of  $\frac{1}{2}$  in. plywood with inside dimensions of 18 by 12 by 12 in. Holes in the top and sides permit escape of heat. The inside is painted with aluminum paint, but this is not necessary with the type lamp used. The light is mounted centrally on the rear of the box. The distance between the chart and light is 11 in. but this distance is not critical.

The chart is 12 by 12 in. in size, held flat between two sheets of  $\frac{1}{8}$ -in. glass of this same size. It is placed "backwards" in the frame so the image will appear normal. The front glass is clear double strength window glass but between the chart and lamp opal glass is used for good diffusion. The glass-chart "sandwich" is held together by slipping the assembly into a slot arrangement in the front of the instrument.

The chart, 12 by 12 in. square between the glass plates, is in outline form somewhat smaller as will be noted. Numerical values have been assigned to each line. Value No. 1 was arbitrarily selected with square block letters  $\frac{1}{8}$ -in. wide and  $\frac{1}{8}$ -in. high drawn with  $\frac{1}{16}$ -in. thick lines and having  $\frac{1}{16}$ -in. spacing between letters. Other values may be noted in Table I which gives the specification for each line on the chart.

The values assigned are arbitrarily selected and have no direct relationship to any existing method for a similar test.

The distance between the test specimen and the chart is also an arbitrary distance established for normal vision.

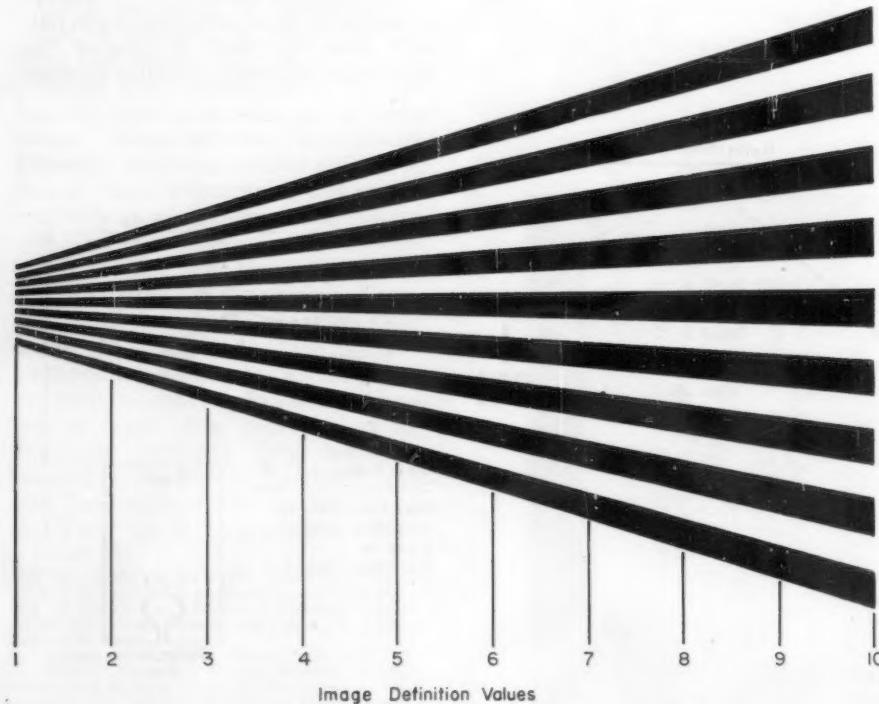


Fig. 5.—Experimental Test Charts.

TABLE II.—IMAGE DEFINITION VALUES AS RATED BY A NUMBER OF OBSERVERS ON SEVERAL DIFFERENT TYPES OF WALLBOARD.

Wallboard Color	Trained Observers			Untrained Observers			
	A	B	C	D	E	F	G
Yellow	4-5	4	4-5	4-5	5	4-5	5
Peach	5	5	6	5	6	5-6	6
White	2-3	2-3	3	3	3	3-4	3
Green	9-10	9-10	10	9	10	10	10
Blue	4	4	4-5	4-5	5	5	5

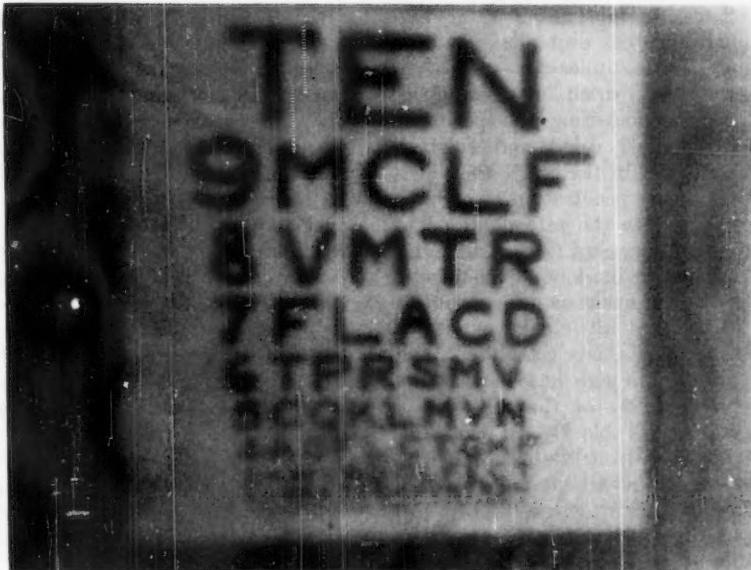


Fig. 6.—Photographed Image Taken on a Wallboard Finish Having an Image Definition Value of Five.



Fig. 7.—Photographed Image Taken on Wallboard Having an Image Definition Value of Three

With a glass mirror, the working distance could have been established at 36 in. between chart and surface to be examined, and still have line 1 (value 1) clearly legible to anyone with normal vision. However, this distance is too great for material like baked finishes on hardboard for, if set at 36 in., it would not be possible to obtain an image definition value of less than about 4 or 5 for good material. So an arbitrary distance of 24 in. has been established between the chart and the surface to be examined.

It has been mentioned that a viewing angle of 25 deg is within the working range for evaluating image definition. The panel is viewed as illustrated in Fig. 4. This position allows the observer latitude in raising and lowering his head to look at several areas and does not confine the inspection to a fixed area.

#### OBSERVER CORRELATION

Five different types of wallboard, all of different color, were evaluated by seven individuals. Three observers (A, B, and C) were trained; two (D and E) use the instrument infrequently; and observers F and G had only several minutes of instruction prior to making their evaluations. The tabulation in Table II of the values observed indicates that rather close agreement may be expected among observers.

#### SUMMARY

An instrument has been devised for measuring the property of image definition which is of value in judging the appearance of material such as decorative wallboard. Different observers can easily evaluate this property and arrive at concordant results. The instrument is quite inexpensive and can be easily constructed. It has proved to be of value in development work where new types of finish are compared against standard material. Also it is helpful in day-to-day control.

While this instrument was developed primarily for use with decorative wallboard, it can be used on many industrial finishes. An application for patent has been filed covering the unit and this method of determining image definition.

## Discussion of Paper on Screening Stainless Steels from the 240-Hr Nitric Acid Test by Electrolytic Etching in Oxalic Acid<sup>1</sup>

MR. D. J. CARNEY.<sup>2</sup>—Mr. Streicher is to be congratulated on presenting the results of a careful study of the qualitative correlation of the electrolytic oxalic acid etch and the corrosion rate in boiling nitric acid. The writer agrees wholeheartedly with the author that the 240-hr boiling nitric acid test for susceptibility to intergranular corrosion is both costly and time consuming. A quick test which would give results comparable to the nitric acid test would be very desirable. The data we have obtained in the past three years correlating qualitatively the appearance of a stainless specimen after electrolytic polishing in oxalic acid and the corrosion rate in boiling nitric acid agree very well with the data of Mr. Streicher's paper. However, early in 1952, South Works of the United States Steel Corp. initiated an investigation to determine if a quantitative instead of a qualitative correlation could be obtained so that the human element could be eliminated.

It is known that acids such as nitric, chromic, and oxalic, when used as electrolytes, attack carbides. By varying the time, temperature, current density, and voltage in electrolytic attack, it was believed that the weight loss of a given sample would correlate to some degree with the weight loss in the 65 per cent boiling nitric acid test. This is possible since, as stated very well by Mr. Streicher in his paper, the attack in either boiling nitric acid or the electrolytic etch is qualitatively the same, that is, intergranular; the difference in the attack is one of degree only.

To determine if the electrolytic test was feasible, a cell was designed as follows: The electrolytic cell consists of a glass jar, 7 by 6 by 12 in., capable of holding 5 liters of electrolyte. The specimen to be tested is made the anode and two stainless steel plates, type 304L, 5 by 6 by  $\frac{1}{4}$  in. serve as cathodes. The applied voltage and current are controlled by suitable electrical connections at any desired level to yield a specific current density and voltage.

The steel to be tested is heat-treated and machined to approximately 1 by 2 by  $\frac{1}{4}$  in. A  $\frac{1}{4}$ -in. hole is drilled near one end to facilitate suspension in the

cell. The samples are finished on a 120 grit belt and the dimensions are measured. The specimens are degreased in alcohol, washed in running water, and preboiled in 20 per cent nitric acid for 15 min. The samples are washed in running water, dried, and weighed. After electrolytic testing, the specimens are again washed, dried, and weighed. The weight loss in the cell is then converted to inches penetration per month and compared to the rate obtained in the boiling 65 per cent nitric acid test.

To date approximately 200 tests have been conducted using 65 per cent nitric acid, 20 per cent nitric acid, or 10 per cent oxalic acid as the electrolyte. The information obtained has shown that the reproducibility of the cell test is very good (see Table I) and that the results obtained from the use of 10 per cent oxalic acid as an electrolyte correlate quite well with the results from the nitric acid corrosion test. A marked difference exists between the electrolytic cell rates of a sample with a 65 per cent boiling nitric acid rate below 0.0010 in. penetration per month and a nitric acid rate above 0.00200 in. penetration per month. Some of the results obtained are summarized in Fig. 1.

Further efforts are being made to obtain additional data to substantiate the trends obtained to date. Type 304L stainless steel has been the only grade tested thus far; however, in the near future, types 304, 316, and 347 are to be tested.

As compared to the electrolytic oxalic acid etch test method proposed by E.

I. du Pont de Nemours and Co., Inc., the test used at South Works has certain advantages. These advantages are: (1) With the weight loss method, visual examination is not necessary, therefore eliminating a source of human error. (2) Both methods can be used at present solely as acceptance tests. At present, if the weight loss in the electrolytic cell is high, specimens should be tested in 65 per cent boiling nitric acid. However, indications are that with the weight loss method, a greater percentage of heats may be accepted without subjecting them to the standard 65 per cent boiling nitric acid test. Verification of this claim will require additional data. (3) In both tests, the electrolytic cell conditions and sample preparation are important. It is expected that if the weight loss system is used in preference to the polishing system, more care will probably be exercised in preparing samples and controlling cell conditions.

The present objective of the electrolytic corrosion test program is to determine the degree of correlation between the electrolytic cell weight loss and boiling 65 per cent nitric acid weight loss for certain grades of stainless steel. When a fair correlation is established, samples can be screened by the weight loss method more easily than by the oxalic acid etch visual test method. As a long range program, if exceptional correlation is established between the electrolytic cell weight loss and the boiling 65 per cent nitric acid weight loss, the standard boiling 65 per cent nitric

TABLE I.—REPRODUCIBILITY OF ELECTROLYTIC WEIGHT LOSS METHOD.

Penetration Rate (Electrolytic Cell), in. per month	Penetration Rate (Boiling 65% Nitric Acid), in. per month	Current Density, amps per sq in.	Voltage, v	Time of Test, min
20 PER CENT NITRIC ACID.				
0.6266	0.00195	0.200	7.0	15
0.6263	0.00195	0.190	7.0	15
0.6320	0.00195	0.200	7.0	15
0.6320	0.00122	0.199	7.0	15
0.6520	0.00122	0.200	7.0	15
0.6664	0.00261	0.199	7.0	15
0.6701	0.00261	0.200	7.0	15
10 PER CENT OXALIC ACID.				
1.910	0.00090	1.00	7.0	30
1.930	0.00090	1.00	7.0	30
1.920	0.00103	1.00	7.0	30
1.925	0.00103	1.00	7.0	30
1.960	0.00122	1.00	7.0	30
1.965	0.00122	1.00	7.0	30
1.580	0.00082	1.00	7.0	30
1.570	0.00082	1.00	7.0	30
1.960	0.00126	1.00	7.0	30
1.950	0.00126	1.00	7.0	30
1.900	0.00127	1.00	7.0	30
1.890	0.00127	1.00	7.0	30

<sup>1</sup> Michael A. Streicher, "Screening Stainless Steels from the 240-Hr Nitric Acid Test by Electrolytic Etching in Oxalic Acid," *ASTM BULLETIN*, No. 188, February, 1953, p. 35 (TP 27).

<sup>2</sup> Chief Development Metallurgist, United States Steel Corp., Chicago, Ill.

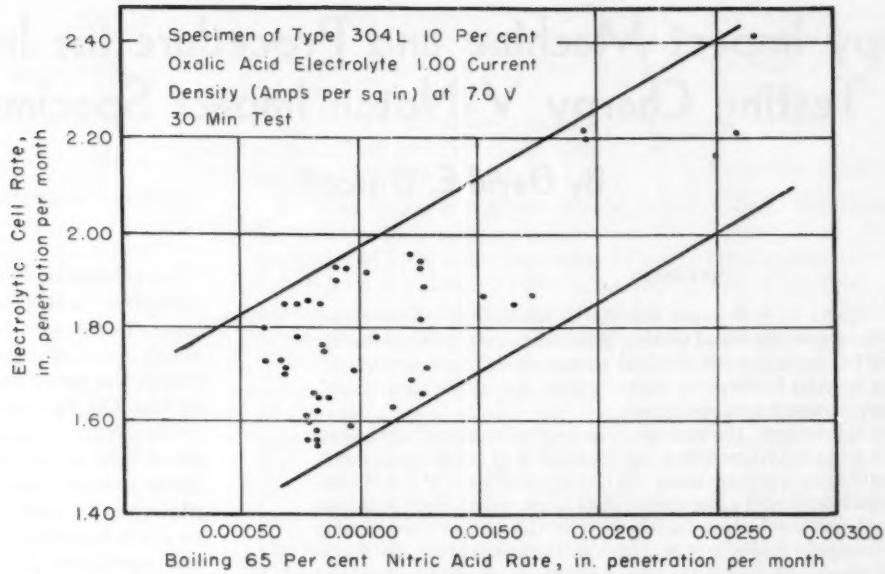


Fig. 1.—Comparison of Electrolytic Cell Corrosion Rates with Boiling 65 per cent Nitric Acid Rates.

acid test may be eventually replaced. Our present results are encouraging enough to warrant a careful and thorough study of the electrolytic weight loss method.

**MR. STREICHER (author's closure).**—Development work was begun at du Pont in July, 1950, on the relationship of certain oxalic acid etch structures to nitric acid corrosion rates. It was found that the oxalic acid etch structures produced on some austenitic steels can be divided into the three well-defined groups described in the paper as step, dual, and ditch structure. By evaluation of the etch structures in accordance with these criteria the steels can be divided into two groups: Those that do not, and those that do, drop grains in the nitric acid test. In terms of nitric acid corrosion rates it has generally been found that steels having a 240-hr rate of 0.0010 in. per month or more are dropping some grains in the nitric acid test. Therefore, the oxalic acid screening test eliminates from nitric acid testing those steels which would have 240-hr rates of about 0.0010 in. per month or less. We have found that the percentage of steels which can be eliminated from nitric acid testing by the oxalic acid screening test is 75 to 90 per cent for AISI types 304 and 316 and about 50 per cent for sensitized

(1 hr 1250 F) type 304L. Any simple method of increasing the 50 per cent screening rate on sensitized 304L steels is, of course, very desirable.

Mr. Carney has proposed a weight-loss method, whose purpose is to increase the number of (type 304L, sensitized) stainless steels which can be screened from the nitric acid test. The main requirement for such a test is that it can distinguish between stainless steels having a nitric acid corrosion rate in the range of 0.0010 to 0.0020 in. per month and rates greater than 0.0020 in. per month. If I have correctly interpreted Mr. Carney's Fig. 1, based on 46 points, any steel which has an oxalic acid weight-loss rate greater than about 1.85 in. per month could have a nitric acid corrosion rate in excess of 0.0020 in. per month, that is, a failing rate, and would, therefore, have to be submitted for the nitric acid test. Yet this same steel could also have as low a nitric acid rate as 0.0006 in. per month. Within this range of nitric acid corrosion rates, 0.0006 to 0.0020 in. per month, may be found steels containing no intergranularly precipitated carbides, and steels whose grains are entirely enveloped by carbide precipitate.

Also, at an electrolytic oxalic acid corrosion rate of 2.00 in. per month a steel could have a rate in the range of

0.0011 to 0.0025 in. per month (maximum permissible nitric acid corrosion rate for 304L, sensitized, 1 hr 1250 F, is 0.0020 in. per month). Thus, the data of Fig. 1 do not make it possible to differentiate by means of the electrolytic oxalic acid weight-loss method between steels having a nitric acid corrosion rate in the range of 0.0010 to 0.0020 in. per month and those above 0.0020 in. per month. The results of further comparisons of the oxalic acid weight-loss test and the nitric acid test, especially in the range of 0.0015 to 0.0025 in per month will be of interest.

The last sentence of Mr. Carney's second paragraph in reference to statements made in my paper could lead to a misunderstanding of the subject as discussed on page 36. The attack on certain austenitic stainless steels produced by electrolytic etching in *oxalic acid* differs *qualitatively* for steels containing intergranularly precipitated chromium carbides (ditched) from those free of such carbides (steps). In contrast, the attack of boiling 65 per cent nitric acid produces ditches on both carbide-free and carbide-containing grain boundaries. Thus the difference in corrosive attack by nitric acid in the presence or absence of intergranularly precipitated carbides is one of degree only.

# The Charpy Impact Machine and Procedure for Inspection and Testing Charpy V-Notch Impact Specimens

By David E. Driscoll<sup>1</sup>

## SYNOPSIS

The principal objects of this paper are (1) to summarize effects which variables in specimen geometry and testing procedures may produce on the results of notched bar impact tests, and (2) to describe the procedure used at the Watertown Arsenal Laboratory in the inspecting and testing of standard V-Notch Charpy impact test specimens.

In order to accomplish these, the various steps to obtain impact test values have been considered in detail, pointing out features that could cause incorrect values. After exhaustive tests using the Charpy machines at the Watertown Arsenal Laboratories and after cooperative work with other Ordnance establishments and private testing facilities, it is the author's conclusion that, if the Charpy impact machine is in proper working condition, the specimens are properly machined, and if the personnel are trained to understand the importance of testing techniques and to follow these techniques, the machines should produce reliable results. Under these conditions, variable results should be due to variation in the material characteristics of the specimens tested.

**A**LTHOUGH impact testing has been used for years, it has been considered too often as "simple—routine."

Also, "scatter" in energy values obtained on Charpy test specimens often has been attributed to the machine and not to actual variations among the samples of materials tested. It has not always been realized that careful procedures and use of the machine can insure that scatter will be due only to variations in the materials. Thus sometimes, the machine has been branded as unreliable.

Proper procedures for the use of the Charpy machine are essential when testing some of today's high-strength, low-impact-value materials. It is obvious that test results, in this low-value region especially, must be free of extraneous effects if the values are to be meaningful. Since in the past five years more and more uniformity and quality specifications for high-strength materials have required a sensitive impact test for acceptance, it has been necessary to restudy in detail the Charpy machine, existing Charpy test data and reproducibility information; and those procedures under which the test is conducted. It was felt that such a study might reveal the causes for wide variations in notched-bar test results that often have occurred. These causes could

then be eliminated or minimized. Thus, the Charpy impact test would be a sensitive, more accurate means of measuring uniformity and quality.

Four distinct features that could cause variations in results are: (1) the calibration and maintenance of the testing machine, (2) the preparation of the test specimen, (3) the technique used in conducting the test, and (4) the quality and uniformity of the material being tested. While these same factors must also influence the reliability and reproducibility of all mechanical property tests such as tension, hardness, etc., the impact test is more sensitive to these factors than are the other tests.

## SUGGESTED PROCEDURE

Based on the experience of those at the Watertown Arsenal in compiling impact-test data for over 20 yr, the procedure described below is recommended.

### *Calibration of the Charpy Machine:*

The calibration should be in accordance with that described clearly in Calibration of Pendulum Type Machines, 1952 ASTM Book of Standards, Part 1, Ferrous Metals, p. 1460.

### *Maintenance of the Charpy Machine:*

After verifying the calibration of the machine, it is then necessary to inspect the various parts of the machine as follows:

1. The shoulders which support the specimen in the Charpy machine must have an angle of 90 deg  $\pm$  10 min.

This is important, as a greater variation will often induce spinning in the specimen when it is broken. The spinning in many cases will jam the specimen between the pendulum and side supports of the Charpy machine, causing erroneous, high values, which will vary, depending on the amount of jamming, up to 1000 per cent. Records are available showing values of 55 ft-lb obtained on a machine at a private facility where the specimens show positive evidence of jamming, whereas duplicate specimens tested at the Watertown Arsenal Laboratory produced results which varied from 4.5 to 5.5 ft-lb. Rough spots or burrs on the supports (Fig. 1) will also produce this effect.

2. The pendulum knife edge must make a perfect contact (top to bottom) with the specimen, when the specimen is resting on the supports (Fig. 2). This can be inspected after applying a light coat of bluing to the surface of the Charpy specimen that comes in contact with the pendulum knife edge since under good testing conditions the surface so treated will show a line from top to bottom of the Charpy specimen.

3. The testing span should be 1.574  $\pm$  0.001 in. and the knife edge of the pendulum should be adjusted to swing through the exact center of this span. A simple fixture can be made to measure this very easily (Fig. 3).

4. A minimum opening of 3 in. will provide a clearance of approximately  $\frac{1}{16}$  in. between the ends of the specimen and the side supports. In most cases this is sufficient to avoid the possibility that the end of the specimen and the fractured surface will become jammed between the pendulum and the side supports of the machine.

5. The machine itself must be tightly bolted to a solid (preferably concrete) foundation. This would appear to be obvious but when inspecting Charpy machines at other installations it has been found that the bolts were so loose it was necessary to take two full turns on the bolts before they were tight. Also, any vibration in the machine itself will tend to produce erroneous values.

### *Preparation and Inspection of Charpy Specimens:*

Fabrication of standard V-notch Charpy impact specimens (Fig. 4) re-

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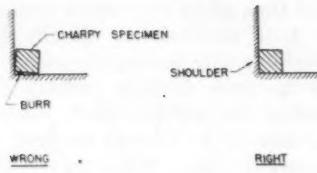


Fig. 1.—Poorly Conditioned Supports.

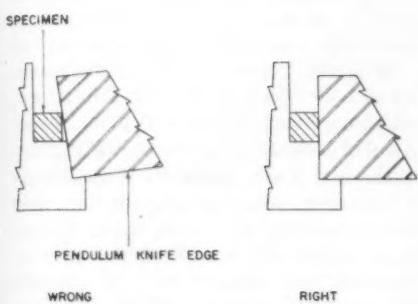


Fig. 2.—Proper Support Alignment.

quires different equipment and procedures than do tension and other round, test specimens. The time required to make the standard V-notch Charpy-impact specimen is approximately 15 min when a moderately large number are machined at one time. This is not considered to be excessively greater than that required for other types of test specimens.

A Blanchard grinder is generally used when a large number of specimens are made in a group. However, the blanks must be fairly uniform in size to minimize the time spent in the grinding operation. The procedure is as follows:

- Blank out the specimens to about  $\frac{1}{2}$  by  $\frac{1}{2}$  by  $2\frac{1}{4}$  in.

- Place a number of specimen blanks on the magnetic chuck or in a vise on the chuck and grind one surface flat. Remove burrs. Grind the opposite surfaces flat, parallel to the first face, down to the finished dimension (0.394 in.).

- Either machine one adjacent face on the shaper or mount a group of specimens in a vise so that the faces to be ground are exactly at right angles to the two faces ground previously. The first method is preferable because the specimens are less liable to be out of square. Greater production is possible with the second method. Remove burrs.

- Grind the fourth and last face of the group.

Notching of impact specimens is generally done by a milling machine using the method described by Siemen.<sup>2</sup>

<sup>2</sup> S. E. Siemen, "Method of Notching Impact Test Specimens," ASTM BULLETIN, No. 139, March, 1946, p. 45.

When the standard V-notch Charpy specimens are received in the laboratory for testing, they should be inspected as follows:

- Use a micrometer or other equally accurate instrument to determine if the specimen is  $0.394 \pm 0.001$  in.

- The opposite surfaces should be flat and parallel, and the adjacent surfaces should have a 90-deg angle. The only tolerance allowed is 0.001 in. out of square across the 0.394-in. width, which corresponds to 10 min. Anything over 0.001 in. may result in erroneous high values. It has been observed that where low energy values are encountered—a brittle material—again there is a tendency to impart a spin to the specimen when it is broken. The spinning may lead to the jamming difficulty described earlier. For example, the Watertown Arsenal Laboratory received six specimens from another laboratory, all machined, and an equal number of blanks for machining. These had been taken from one bar of steel; the machined and blank specimens were alternates. The blanks were machined at Watertown Arsenal Laboratory and then all specimens were checked for radius of notch, depth of notch, specimen size, and squareness.

The entire group of twelve specimens were identical with but one exception: The specimens that had been received finish-machined were 0.003 to 0.004 in. out of square. The values obtained from the specimens machined at this laboratory ranged from 4.8 to 5.3 ft-lb. The specimens received finish-machined, gave values from 4.7 to 10.3 ft-lb, and only one of these (the lowest value) did not jam.

- The distance from the base of the notch to the opposite surface must be  $0.315 \pm 0.001$  in. Use a thread micrometer or suitably designed wedge-shaped depth gage for this measurement.

- The radius at the base of the notch must be  $0.010 \pm 0.001$  in.; any increase above the 0.001 in. allowed will increase the energy value recorded (Fig. 6). The notch angle is specified as 45  $\pm 1$  deg; a 5- or 10-deg change in angle will materially affect the energy values obtained.

Other studies have indicated that a highly polished notch surface is unnecessary since it will produce the same energy values as obtained with a standard milled notch.<sup>3</sup>

- Although the over-all length of the specimen is not as critical as the other dimensions, it should be held to  $2.16 \pm 0.05$  in. If the specimens are

too long there is a greater tendency for the ends of the specimen to jam; if the specimen is too short and the material is ductile the specimen will bend enough to slip by the shoulders without breaking.

#### Technique Used in Conducting the Test:

**Low Temperatures.**—To insure accuracy of results when testing at low temperatures, the procedure described below has been followed.

Use a suitable container approximately 4 in. deep containing a grid raised at least 1 in. from the bottom which is filled with a coolant, such as alcohol or acetone, so that the specimens, when immersed will be covered with at least 1 in. of liquid. This liquid is then cooled to the desired temperatures by the addition of dry ice in powder or lump form. The temperature is regulated by a suitable device. Temperatures from ambient to  $-110$  F can be reached with these mixtures.

Liquid nitrogen can be used alone ( $-319$  F) or in conjunction with alcohol, acetone or isopentane. When used with the latter, the liquid nitrogen is

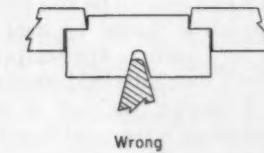
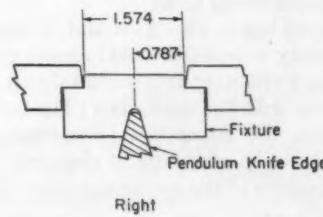


Fig. 3.—Fixture for Centering Pendulum.

Type	A	B	C	D
1	2.16	0.394	0.394	0.315
2	2.16	0.197	0.788	0.158
3	2.16	0.2955	0.2955	0.237
4	2.18	0.197	0.197	0.158
5	1.08	0.197	0.197	0.158
6	6.50	1.182	1.182	0.946

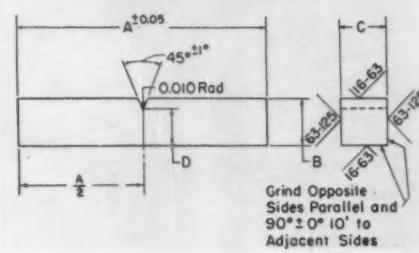


Fig. 4.—Charpy Specimen Dimensions.

poured into an outer bath which surrounds the container holding the isopentane and the specimens. When using this combination, temperatures from ambient to -259 F can be reached but above -110 F isopentane losses make its use uneconomical.

Glass thermometers (pentane, gas) may be used. With most thermometers of this type it is necessary to immerse the entire column of liquid in the glass to insure accurate readings. These thermometers are not always accurate (readings varying as much as  $\pm 10$  F have been encountered); therefore, it is necessary to calibrate them against a Bureau of Standards, standardized thermometer. A potentiometer with a copper-constantan thermocouple welded to a standard specimen can be used, provided accurate calibration data on the copper-constantan wire is available. Bimetallic thermometers with a 3 or 4-in. glassed-in dial should also be calibrated if they are to be used. They are generally accurate however, easily readable, and only 1 in. of the bimetal rod has to be immersed in the liquid. Whatever device is used to measure the temperature of the bath, it should be placed in the center of the group of specimens being tested.

A cold box is also used and, if one of the many acceptable cold boxes is used, having a chamber approximately an 18-in. cube, with the specimens 12 in. below the top, the cover can be opened for a period of 15 min without changing the temperature of the specimens more than 0.5 F.

Investigations have shown that for all practical purposes the specimen will reach the temperature of the liquid bath within 5 min but, to be absolutely sure, all specimens should be held at temperature for 15 min. The temperature of the bath should be held constant within  $\pm 1$  F during the last 5 min before the specimen is removed from the bath and broken. When using a cold box, it should be held at the testing temperature for 30 min.

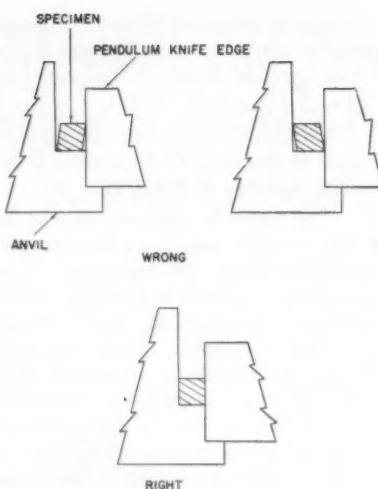


Fig. 5.—Squareness Effect.

Various methods are used to remove the specimen from the coolant and position them in the impact machine. The method at Watertown Arsenal Laboratory is to use a standard pair of tongs (see Fig. 7) with an attachment welded to one of the prongs, which consists of a flat piece of stock 1.572 in. long,  $\frac{3}{8}$  in. wide,  $\frac{1}{16}$  in. thick. On the  $\frac{3}{8}$ -in. surface is a raised vee exactly in the center of the span, this vee being the exact duplicate of the notch in the specimen. The second prong has a similar attachment with two raised vees, which span the vee on the first prong. The tongs are always left in the coolant, except when handling specimens, thus enabling a skilled operator, not only to grasp the specimen firmly with a clamp that is at the same temperature as the specimen, but also to place the specimen in the machine with the knowledge that the notch in the specimen can be held within  $\pm 0.001$  in. of the center of the 1.574-in. span in the Charpy machine.

If a large number of specimens is to be tested, it is advisable to have two sets of tongs and change every four specimens so that neither set will warm

up and thus affect the results obtained. (This tong method has already been adopted by other testing agencies.)

The specimen must be removed from the coolant (preferably alcohol), placed in the supports of the Charpy machine, and broken within 5 sec. When the specimen is first removed from the coolant, the temperature of the specimen is further lowered by the evaporation of the liquid on its surface, but then the specimen rapidly warms up. For example, a specimen removed from acetone at -40 F will drop to -43 F in 2 sec, warm up to -40 F in 5 sec, to -35 F in 10 sec, and to approximately -30 F in 15 sec. Alcohol does not show this radical change in the first 5 sec; generally it maintains a uniform temperature during this period (see Fig. 8). Also, use of alcohol as a coolant will considerably reduce or eliminate the amount of rust appearing on the fractured surface, enabling the operator to describe the fracture more accurately. It is advisable for these reasons to use alcohol as a coolant.

**High Temperatures.**—Elevated temperature tests up to +300 F are conducted by immersing the specimen in agitated oil and holding at test temperature for 15 min. Above 300 F a furnace or heating oven is used, and the specimens are held at temperature 1 hr. It is necessary to place the Charpy specimens in the same area of the furnace that has been shown previously to produce a uniform temperature record on the temperature recording apparatus.

**Room Temperature Tests.**—Ambient temperature tests are often made where the temperature of the room varies from 60 to 95 F. Some are made by testing facilities where the specimens are immersed in a coolant at 70-72 F. Since the transition temperature (where appearance of fracture changes from 100 per cent fibrous) sometimes occurs in this room-temperature range, it is important to note always in the report the test temperature as well as the method used.

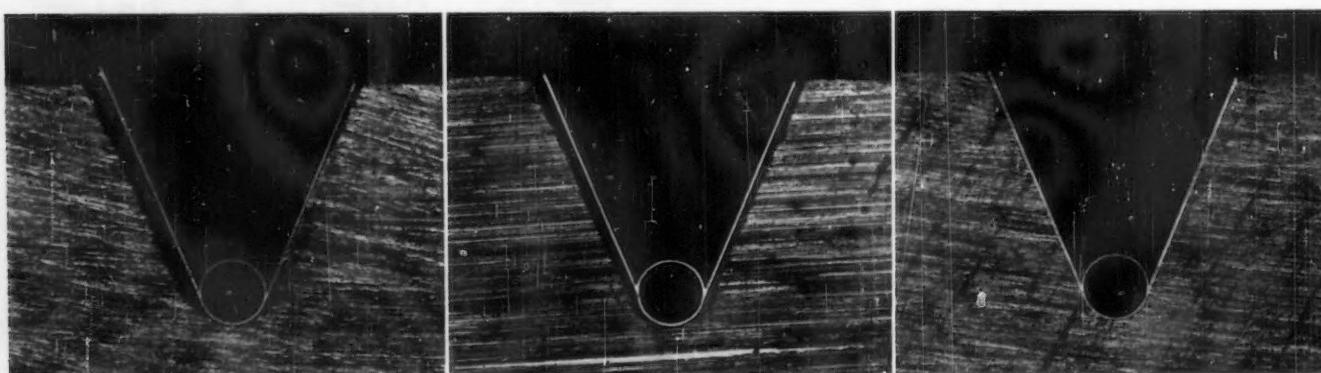


Fig. 6.—Variations Encountered in Charpy Notches.

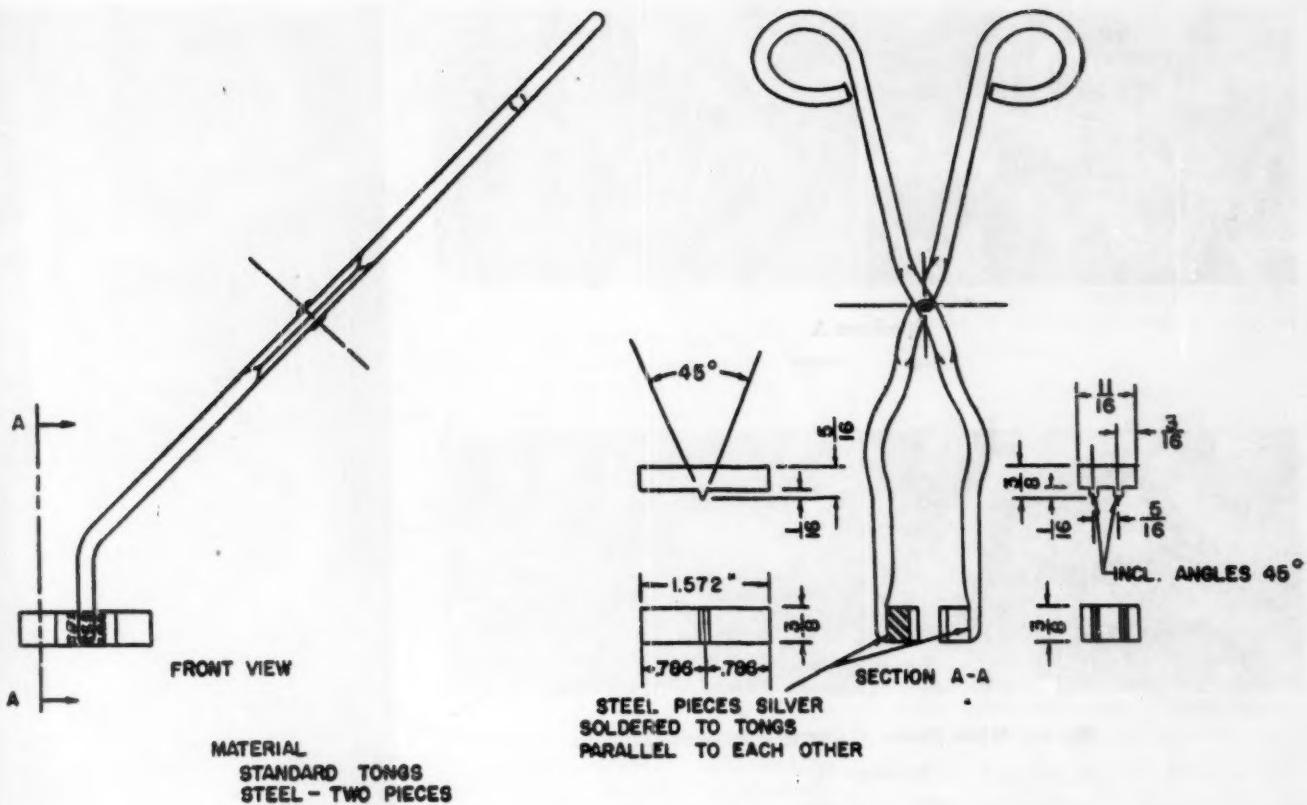


Fig. 7.—Charpy Tongs for Centering Specimens in Machine.

## DISCUSSION AND RESULTS

Watertown Arsenal Laboratory has found that if the procedures outlined above are carefully followed it will be possible to obtain duplicate values (within the normal spread encountered in the material) regardless of personnel or machines. Our records substantiate this.

For example, a large number of notched bar impact specimens were obtained from a plate of steel (18 by 18 by  $\frac{1}{2}$  in.) and were sent to a testing section in small lots over a period of months. There were two machines and four operators involved in these tests, but all values recorded within 1.5 ft-lb (15.0 to 16.5). The fact that a test

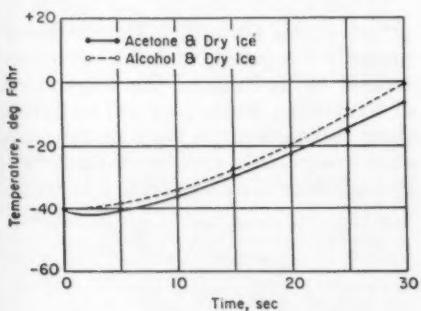


Fig. 8.—Temperature Change in Charpy Specimens.

for reproducibility was being conducted was not known by the personnel or head of the testing section involved until the entire series of tests was completed.

For a second example, a  $\frac{1}{2}$ -in. diam rod of 3140 hot-rolled stock was cut in three parts. Two parts were heat-treated to give medium and high-energy values and the third was left in the hot-rolled condition to obtain low-energy values. These rods were then cut into 12 or 15 parts and were stamped

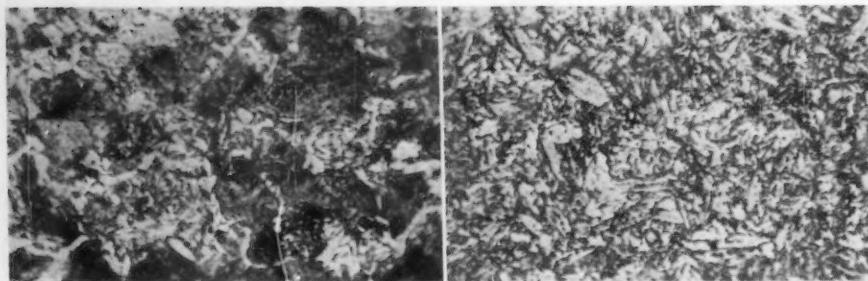
1 to 12 or 1 to 15. Alternate specimens were used on each machine to minimize heat treatment or composition variation in the material. These blanks were then machined and tested with the results, as indicated in Table I.

These results show that with a clean homogeneous, properly heat-treated steel being used, the results obtained on these impact machines, in good condition, varied by no more than approximately 1 ft-lb, regardless of energy level.

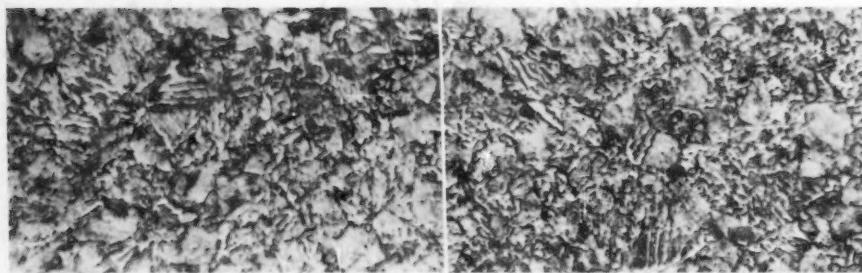
The interest in the Charpy test in

TABLE I.—REPRODUCIBILITY CHECK ON CHARPY SPECIMENS.

217 ft-lb Machine		240 ft-lb Machine		100 ft-lb Machine	
Specimen	Ft-lb	Specimen	Ft-lb	Specimen	Ft-lb
<b>3140 HOT ROLLED</b>					
No. 1....	8.6	No. 2....	8.6	No. 3....	8.9
No. 4....	8.6	No. 5....	8.9	No. 6....	9.7
No. 7....	8.3	No. 8....	8.3	No. 9....	9.4
No. 10....	8.3	No. 11....	8.9	No. 12....	10.0
Average....	8.45		8.68		9.50
<b>3140 HEAT TREATED</b>					
No. 1....	44.1	No. 2....	43.6	No. 3....	44.5
No. 4....	45.3	No. 5....	44.9	No. 6....	45.8
No. 7....	44.9	No. 8....	45.3	No. 9....	46.3
No. 10....	45.8	No. 11....	44.5	No. 12....	45.8
No. 13....	45.3	No. 14....	45.3	No. 15....	44.1
Average....	45.08		44.72		45.3
No. 1....	73.7	No. 2....	74.5	No. 3....	76.5
No. 4....	77.1	No. 5....	77.5	No. 6....	71.5
No. 7....	75.2	No. 8....	75.7	No. 9....	74.5
No. 10....	71.3	No. 11....	71.3	No. 12....	75.5
No. 13....	73.2	No. 14....	74.5	No. 15....	75.0
Average....	74.1		74.7		74.6



Specimen A  
Edge      Center



Specimen B  
Edge      Center

Fig. 9.—Micro Photos of Charpy Specimens.

recent years, due to the increased use of the impact test in specifications, has resulted in many studies of the reproducibility of the Charpy impact test. Those at the Watertown Arsenal Laboratory have cooperated in many of these surveys and feel that the lack of uniformity in quality and heat-treatment of the material sometimes used in such surveys is appalling. When trying to check the uniformity of results obtained on any type of testing machine, it is obviously necessary to obtain a uniform material. But some installations taking part in these surveys, preparing as many as 2000 specimens in a program, use materials sometimes so nonuniform that they produce values which vary as much as 100 per cent.

To illustrate, the Watertown Arsenal Laboratory recently partook in such a survey wherein the laboratory received a group of Charpy blanks. All of these were notched at this laboratory and one third of the specimens was tested. The remainder were returned and tested at other participating installations. This laboratory did, in due course, receive for testing samples that had been notched at other installations. The blanks,

as received, had been very carefully machined; extreme care was taken by the Watertown Arsenal Laboratory to notch exactly according to specifications. These specimens when tested on machines that have shown very uniform results (see Table I), produced values varying as much as 100 per cent. Some specimens machined side by side also showed high variations. To check the reason for this wide variation a pair of specimens that had been taken out of a section of steel side by side were sent out for metallurgical examination. The results reported on these two specimens are described below (see also Figs. 9 and 10).

*Specimen A, 55.9 ft-lb (100 per cent Fibrous).*—The edge showed a nonuniform fibrous structure varying in different areas along the outer surfaces (Fig. 10). The structure in some areas was pearlite, with considerable ferrite in grain boundary and crystallographic planes. The center of the structure was fairly uniform, tempered martensite.

*Specimen B, 34.2 ft-lb (45 per cent Fibrous).*—The edge showed considerable decarburization to a depth of 0.123 in. (average of three measurements).



Fig. 10.—Macro Photo of Charpy Specimen.

Within this decarburized zone, the structure was decidedly bainitic with scattered small grain boundary pools of free ferrite. The center had a structure showing a mixture of tempered bainite (pronounced) and tempered martensite with a strongly evident grain boundary constituent resembling carbides.

The results of metallurgical test on these two specimens (admittedly worse than the average of the lot being tested) show very clearly that the wide variations often reported in these Charpy reproducibility surveys may be sometimes due to the variation in materials being tested rather than the Charpy machine.

#### CONCLUSION

If the Charpy impact machine is in proper working condition, the specimens properly machined, and the personnel trained to understand the importance of the testing techniques and to follow these techniques, the machine can produce comparable results affected only by variations in material characteristics.

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# Stress and Strain at Onset of Crazing of Polymethyl Methacrylate at Various Temperatures\*

By M. A. Sherman<sup>1</sup> and B. M. Axilrod<sup>1</sup>

## SYNOPSIS

The stress and strain at the onset of crazing of polymethyl methacrylate were determined at 23, 50, and 70°C. The materials tested were commercial cast polymethyl-methacrylate sheets of both general-purpose and heat-resistant grades. The tests were made on samples 0.15 in. thick. Load-elongation graphs were made during the tests, and the onset of crazing was observed visually and noted on the graph.

The results indicate that a "critical-strain theory" for the threshold of crazing, as has been suggested for polystyrene by Maxwell and Rahm (1,2)<sup>2</sup> is not applicable to polymethyl methacrylate. The strain at the threshold of crazing tended to decrease with increase in temperature from 23 to 50°C. Between 50 and 70°C no consistent trend for the strain at crazing was detected. The stress at the threshold of crazing was about 80 to 95 per cent of the tensile strength at all temperatures.

**A**N INVESTIGATION of the rheological and crazing properties of polystyrene by Maxwell and Rahm (1,2)<sup>2</sup> indicated that there is a so-called "critical elongation," 0.75 per cent, for its threshold of stress crazing and that this strain is constant for temperatures below 82°C, the second-order transition point for polystyrene. In these experiments to obtain the critical elongation, the time of test was relatively short, ranging from 0.5 to 10 min.

Sauer, Marin, and Hsiao (3) found this critical-elongation hypothesis of crazing to be inconsistent with their data on polystyrene. In some of their short-time tension tests, no crazing was evident up to failure of the specimens at an elongation of about 1.4 per cent. In long-time tests of several hundred hours' duration, crazing was evident at much lower strains than 0.75 per cent. These authors stated that crazing is markedly dependent on the time of load application as well as on the stress or strain magnitude.

An investigation of the crazing characteristics of polymethyl methacrylate at room and elevated temperatures was

undertaken to determine whether a "critical-strain theory" might be applicable for this material for short-time tests. The experiments were made on both general purpose and heat-resistant grades of polymethyl methacrylate at 23, 50, and 70°C. The properties measured were tensile strength, total elongation, modulus of elasticity, and the stress and strain at the onset of crazing. These experiments were carried out as

one phase of a research program to investigate factors affecting crazing of acrylic glazing.

## MATERIALS

Samples of cast polymethyl-methacrylate sheets of general-purpose grade—Lucite HC201 and Plexiglas I-A—and of heat-resistant grade—Lucite HC202 and Plexiglas II—were used. Each of the four samples consisted of three sheets of 0.15-in. nominal thickness, each from a different production run. These sheets, like those used to make laminated acrylic glazing, were masked on one side only with the usual adhesive-coated masking paper. Each sheet was 36 by 48 in. in size.

## TEST EQUIPMENT AND PROCEDURE

The specimens were standard tension test specimens with a 0.5-in. reduced section, Type I of ASTM Method D 638.<sup>3</sup> The tests were conducted in most details according to Method D 638. Load-elongation graphs were ob-

<sup>3</sup> Tentative Method of Test for Tensile Properties of Plastics (D 638-52 T), 1952 Book of ASTM Standards, Part 6, p. 655.

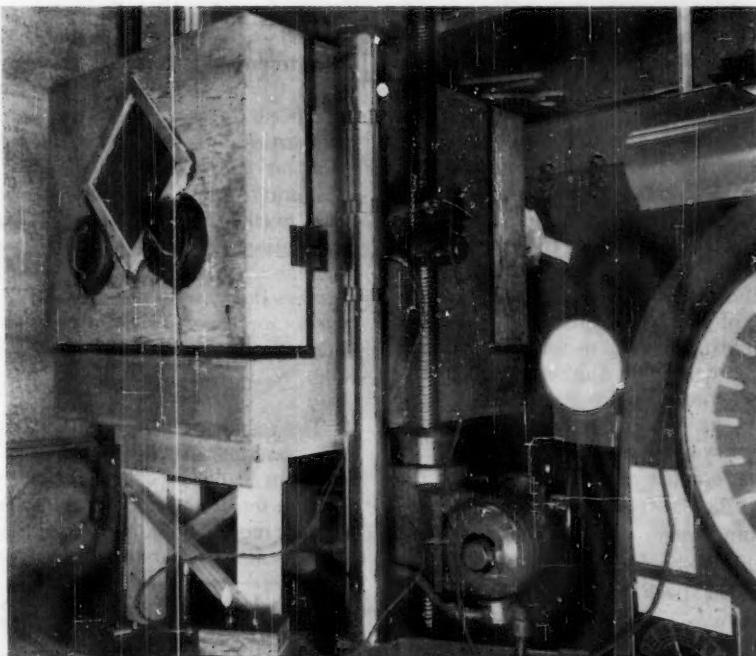


Fig. 1.—Front View of Tension Test Enclosure in Place in Testing Machine; Conditioning Unit Can Be Seen at Right.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

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<sup>2</sup> The boldface numbers in parentheses refer to the list of references appended to this paper.

tained automatically by a strain gage and the associated autographic recorder. The strain gage used was a model PS-7 Southwark-Peters plastics extensometer, a low-magnification nonaveraging type with a 2-in. gage length and a strain range of 50 per cent. The magnification used was 20. The onset of crazing was noted on the load-elongation graph.

The tension tests were made in an insulated temperature-controlled cabinet that had been used previously for determining the tensile properties of laminated plastics (4). The cabinet was set up in a 60,000-lb capacity universal hydraulic testing machine as shown in Fig. 1. This machine was located in a controlled atmosphere room operated at 23 C and 50 per cent relative humidity. Inside the cabinet (Fig. 2) were the tensile grips and strain gage, the latter mechanically connected by a torque tube to the Selsyn motor outside the cabinet. The motor activated the autographic recorder to produce the load-elongation graphs. On the front of the box were armholes to permit manipulation of the specimen and gage. In the rear panel of the cabinet were two openings for the circulation of air through insulated flexible tubes from the conditioning unit shown at the right in Fig. 1. Also inside the testing cabinet in the left rear corner was a lamp—a gooseneck desk type with hemispherical reflector—so placed as to permit observation of crazing as it developed on the specimens. The crazing was observed by looking through the right-corner of the triple-paned 12 by 12-in. window on the front of the box. Black paper placed on the left and rear walls of the cabinet provided a suitable background. Because of the position of the Selsyn motor which couples mechanically to the gage, the plane of the flatwise surface of the specimen was necessarily perpendicular to the window, as is shown in Fig. 2. Although this meant that the observer looked quite obliquely through the specimen, the crazing was not difficult to see.

The tests at 23 C were made with the cover of the box in place in order that the lighting conditions for observing the crazing would be the same as at the higher temperatures. As the light inside the box produced considerable heat, it was necessary to place dry ice in the conditioning unit to run the test at 23 C. The relative humidity in the box under these conditions was found to be between 48 and 49 per cent.

For the tests at 50 and 70 C, each specimen was placed in the box approximately 0.5 to 1 hr before it was tested. All specimens had been conditioned at 23 C and 50 per cent relative humidity

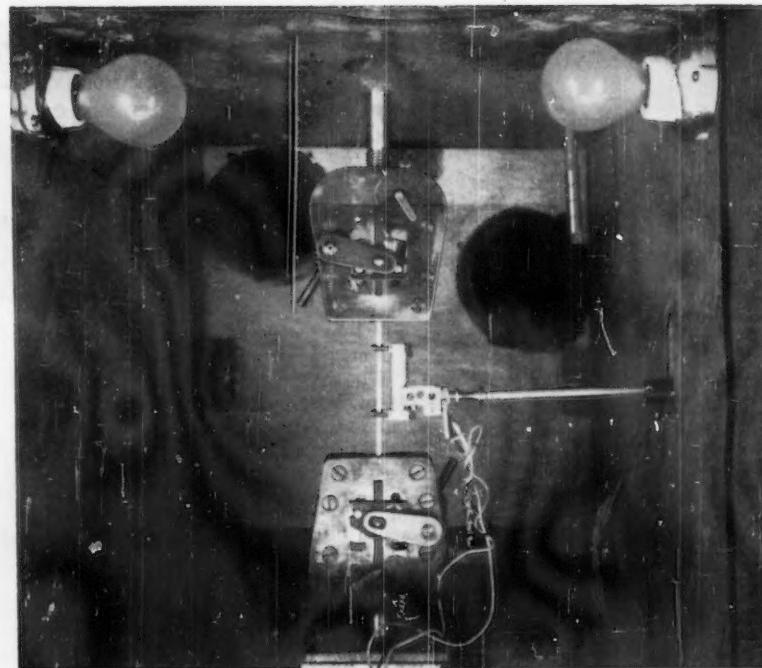


Fig. 2.—Interior View of Tension Test Enclosure with Specimen in Grips and Extensometer Attached.

Lamp used for observing crazing is not shown; this lamp was placed in rear left corner of box. Two lights shown in upper corners were out while crazing was being observed.

for a period of at least 3 weeks before the test.

Up to 10 per cent elongation of the specimen, the tests were run at 0.05 in. per min. As the specimens at elevated temperature sometimes stretched 100 per cent or more, the gage was removed at the 10 per cent elongation point and the rate of head motion increased to about 0.6 in. per min. The permanent set of the specimen within a few minutes after breaking was measured with a steel scale. This increase in speed did not affect the values for properties reported other than elongation, as the crazing occurred and the maximum strength at 0.05 in. per min was reached at less than 10 per cent elongation. The load on the specimen increased, of course, when the speed was increased to 0.6 in. per min and, in some cases, increased to a value above the maximum for 0.05 in. per min.

#### RESULTS OF TESTS

The results of the tension tests on the four samples at 23, 50, and 70 C are given in Table I.<sup>4</sup> The average values for the tensile strength, permanent set, secant modulus of elasticity, and the stress and strain at the onset of crazing

<sup>4</sup> The values of strain at crazing and the values for range of secant modulus of elasticity reported in Table II of NACA Technical Note TN 2778 differ slightly from the values given in this paper owing to an error made in reading strain data from the load-elongation graphs. The statistical analysis of the data on strain at crazing was re-examined on the basis of the revised data.

are given for each of the materials. Statistical analysis of the tensile strength and the strain at the threshold of crazing showed sheet-to-sheet variation for most of the samples. Therefore, ranges are given as a measure of the dispersion rather than a standard deviation or standard error value. The values of tensile strength and of stress at the onset of crazing for the four materials are shown graphically in Fig. 3, the modulus values in Fig. 4, and the values of the permanent set and the strain at the onset of crazing in Fig. 5.

#### Strength Properties:

As can be seen in Fig. 3, the tensile strength decreases quite linearly for all materials as the temperature is increased. For the general-purpose-grade samples, the strength at 50 C is about 60 per cent of its value at 23 C; at 70 C it is 28 per cent of the strength at 23 C. For the heat-resistant-grade samples, the strength at 50 C is two thirds that at 23 C, and at 70 C it has been reduced to a little less than one half of the value at 23 C. The values of the tensile strength at 70 C for the Plexiglas samples agree closely with those published by the Rohm & Haas Co., Inc. (5). The values in the present report are 2300 and 5100 psi for the general-purpose and heat-resistant grades, respectively; the values from reference (5) are 2400 and 5000 psi for the same materials, respectively. The rate of

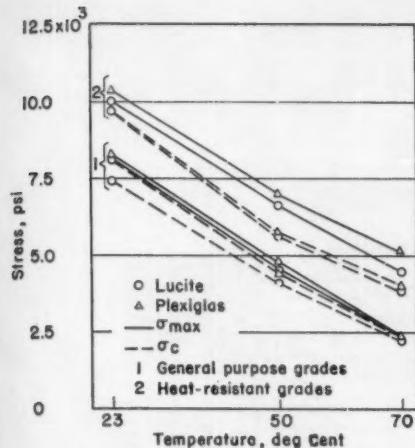


Figure 3.—Variation of Tensile Strength  $\sigma_{\text{max}}$  and Stress at Onset of Crazing  $\sigma_c$  with Temperature for Acrylic Plastics.

crosshead motion for the tests described in reference (5), however, was 0.2 in. per min compared with 0.05 in. per min for those described here.

The secant modulus of elasticity was found in each case for a stress range of from zero to about one half of the maximum stress, as is shown in Table I. The modulus also decreases as the temperature increases, as Fig. 4 shows. For the two general-purpose-grade samples, the modulus decreases more rapidly than for the heat-resistant grades; at 70 C it is about 40 per cent of its value at 23 C. The modulus values at 70 C for Lucite HC202 and Plexiglas II are about 60 and 70 per cent, respectively, of their values at 23 C.

Since all specimens were tested in the same way, the permanent-set values give some idea of the change in elongation with temperature. As the strain at failure is a flaw-dependent property, the dispersion for total elongation and hence for the permanent set would be expected to be high. The ranges in Table I show this to be the case. It will also be noticed that the permanent set increases considerably with rise in temperature. This, of course, is expected as the material approaches its rubbery state, which begins at about 110 and 130 C for the general-purpose and heat-resistant grades, respectively. The values of permanent set for the general-purpose-grade material are higher than the corresponding values for the heat-resistant grade except in one case. This exception, for Lucite HC201 at 23 C, is probably not significant. The permanent set values for the general-purpose-grade material at 70 C could not be obtained as the maximum separation of the grips in the elevated temperature test was quite limited.

The maximum grip separation corresponded to a permanent set of about 2.2 in. for the 2-in. gage length or about 110 per cent.

#### Crazing Properties:

From 23 to 50 C, the strain at the threshold of crazing decreases significantly for all materials. From 50 to 70 C, the crazing strain (Fig. 5) apparently increases for the two general-purpose-grade materials and decreases for the heat-resistant grades. A statistical analysis shows that only for Plexiglas II is a difference between 50 and 70 C values significant. This indicates that for all the materials the strain at the threshold of crazing is not constant even for temperatures considerably less than the second-order transition point. The second-order transition points are between 75 and 80 C for general-purpose grade and about 94 to 95 C for the heat-resistant polymethyl methacrylate.<sup>5</sup>

<sup>5</sup> These values were obtained from volume-temperature measurements on these samples for the temperature range 25 to 110 C; a mercury dilatometer was used.

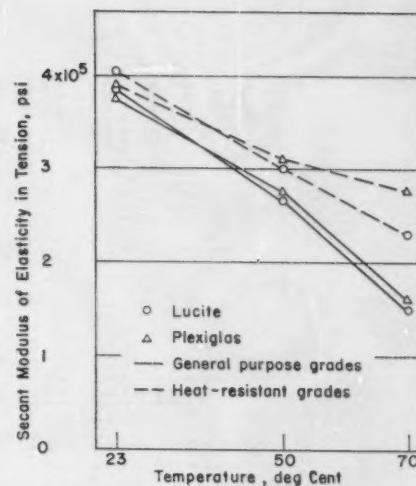


Fig. 4.—Variation of Tensile Secant Modulus of Elasticity with Temperature for Acrylic Plastics.

Stress range is zero to about one half of tensile strength.

In Fig. 6 the strain at the threshold of crazing is shown on the same graph with total-elongation data at various temperatures for three samples of poly-

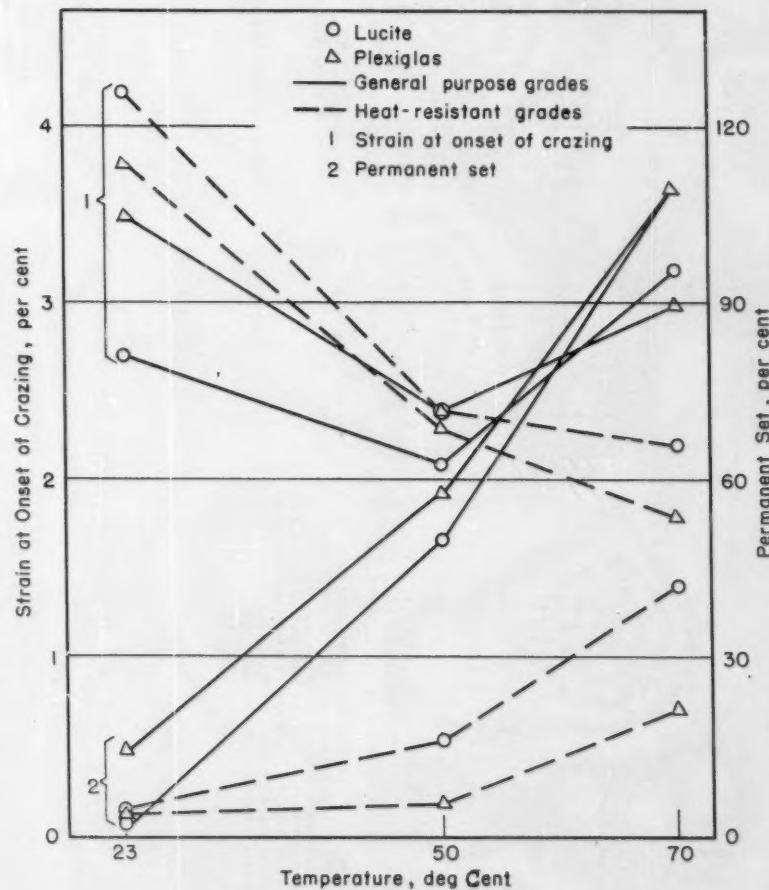


Fig. 5.—Variation of Strain at Onset of Crazing and Permanent Set with Temperature for Acrylic Plastics.

TABLE I.—RESULTS OF TENSION TESTS OF POLYMETHYL-METHACRYLATE SPECIMENS AT 23, 50, AND 70 C.<sup>a</sup>

Material	NBS Sample	Temperature, deg Cent	Tensile Strength, $\sigma_{max}$ , psi			Stress at Onset of Crazing, $\sigma_c$ , psi			Strain at Onset of Crazing, per cent			Modulus of Elasticity Data <sup>f</sup>				
			Average	Range	Average	Range	Average	Range	Average	Range	Average	Average	Range	Range		
Lucite HC201 . . .	L1d	23	8.06 $\times 10^3$	7.86 to 8.21 $\times 10^3$	7.4 $\times 10^3$	7.2 to 7.5 $\times 10^3$	9.1	1.5	2.1 to 3.0	0 to 4.0 $\times 10^3$	385 $\times 10^3$	360 to 440 $\times 10^3$				
	L2d	50	4.53 $\times 10^3$	4.36 to 4.82 $\times 10^3$	4.1	3.9 to 4.3	9.0	1.5	1.9 to 2.5	0 to 2.5	265	250 to 290				
		70	2.28	2.03 to 2.43	2.2	2.0 to 2.4 <sup>c</sup>	9.6	>110 <sup>e</sup>	2.1 to 5.7	0 to 1.2	150	120 to 230				
Lucite HC202 . . .	L1d	23	10.00	9.76 to 10.3	9.7	9.4 to 10.2	9.7	4	4.2	3.7 to 5.2	0 to 5.0	405	380 to 430			
	L2d	50	6.60	6.37 to 6.83	5.6	5.1 to 6.1	85	16	2.4	2.0 to 2.9	0 to 4.0	300	260 to 330			
		70	4.43	3.99 to 4.92	3.8	3.2 to 4.2	86	42	9 to 60	1.7 to 2.6	0 to 2.5	230	200 to 260			
Plexiglas I-A . . .	P1a	23	8.22	8.07 to 8.35	8.0	7.9 to 8.2	98	14	2 to 36	3.3 to 3.7	0 to 4.0	375	350 to 390			
	P2a	50	4.77	4.64 to 5.13	4.5	4.2 to 4.6	94	58	22 to 126	2.0 to 2.8	0 to 2.5	275	250 to 300			
		70	2.31	1.97 to 2.54	2.3	1.9 to 2.5 <sup>c</sup>	99	>110 <sup>e</sup>	3.0	2.2 to 4.6	0 to 1.2	160	150 to 180			
Plexiglas II . . .	P1a	23	10.35	9.85 to 10.8	9.7	9.2 to 10.2	94	3	1 to 6	3.8	3.3 to 4.2	0 to 5.0	390	370 to 400		
	P2a	50	6.96	6.42 to 7.82	5.7	5.4 to 5.9	82	5	2 to 8	2.3	1.9 to 2.5	0 to 4.0	310	280 to 340		
		70	5.10	4.42 to 5.83	3.9	3.5 to 4.6	75	21	2 to 70	1.8	1.7 to 2.1	0 to 2.5	275	250 to 310		

<sup>a</sup> Tests were made on standard tensile specimens, Type I of ASTM D 638-52 T. Testing speed was 0.05 in. per min up to 10 per cent elongation of specimen; strain gage was removed at this point and testing speed was increased to about 0.6 in. per min.

<sup>b</sup> Tensile strength is based on maximum load attained at testing speed of 0.05 in. per min.

<sup>c</sup> For five specimens. On one specimen a group of six, onset of crazing occurred beyond the yield point and this value was not included.

<sup>d</sup> Measured within a few minutes after specimen broke.

<sup>e</sup> Specimen did not break. Experimental setup did not permit greater separation of grips than an amount corresponding to a permanent set of about 2.2 in.

<sup>f</sup> For stress range indicated in each case.

TABLE II.—STRESS AND STRAIN AT THRESHOLD OF CRAZING FOR POLYMETHYL-METHACRYLATE SAMPLES FROM TENSION TESTS AT 23 C.<sup>a</sup>

NBS Sample	Preloading Stress, psi <sup>b</sup>	Tensile Strength, $\sigma_{max}$ , psi			Stress at Onset of Crazing, $\sigma_c$ , psi			Strain at Failure, <sup>c</sup> per cent			Strain at Onset of Crazing, <sup>c</sup> per cent		
		Average	Range	Average	Range	Average	Range	$\sigma_c/\sigma_{max}$ , per cent	Average	Range	Average	Range	Range
L1d . . .	2.0 $\times 10^3$	8.00 $\times 10^3$	7.65 to 8.31 $\times 10^3$	6.6 $\times 10^3$	6.4 to 7.0 $\times 10^3$	8.3	1.5	3.4 to 7.4	2.0	1.8 to 2.3			
L2d . . .	3.0	9.73	9.22 to 10.1	7.4 to 8.9	7.4 to 8.9	85	1.5	3.4 to 16.6	2.5	2.0 to 3.0			
* P1a . . .	2.4	8.13	7.94 to 8.38	7.4	7.1 to 7.9	91	24-d, <sup>e</sup>	13 to 40 d, <sup>e</sup>	2.3	2.3 to 3.1 <sup>d</sup>			
P2a . . .	3.0	10.0	9.0 to 10.5	8.5	7.7 to 9.3	85	7.0 <sup>d</sup>	3.1 to 9.8 <sup>d</sup>	2.6	2.1 to 3.2 <sup>d</sup>			
L1d . . .	3.0	7.93	7.62 to 8.13	6.74	6.2 to 7.0 <sup>d</sup>	84	6.3	4.5 to 9.0	2.1 <sup>d</sup>	1.8 to 2.5 <sup>d</sup>			
L2d . . .	4.0	9.69	9.44 to 9.99	8.0	7.1 to 8.5	82	6.9	4.1 to 10.2	2.4	1.9 to 2.7			
P1a . . .	3.2	8.10	7.90 to 8.25	7.3	6.8 to 7.9	90	>18.8	8.6 to >55	2.6	2.2 to 3.2			
P2a . . .	4.0	10.3	9.86 to 10.5	8.8	8.2 to 9.4	86	8.4	7.6 to 9.5	2.8	2.3 to 3.2			

<sup>a</sup> Tests were made on standard tensile specimens, Type I of ASTM D 638-52 T. Testing speed was 0.05 in. per min. Specimens were conditioned at 23 C and 50 per cent relative humidity at least 3 weeks prior to test. Six specimens, one from each half of each sheet of a sample, were tested for each average.

(Data from reference (7).)

<sup>b</sup> Specimens were subjected to this stress for 5 min to correspond to stress used for stress-solvent crazing of other sets of specimens for another investigation (7). There is no significant difference between the two sets for any sample.

<sup>c</sup> Load-elongation graphs were obtained with a Southwark extensometer and associated recorder.

Crazing was observed visually as described in text.

<sup>d</sup> For five specimens.

<sup>e</sup> Two values estimated from permanent set. Gage was removed from these two specimens at 10 per cent elongation and crosshead speed was increased to approximately 0.6 in. per min.

methyl methacrylate. These elongation data were obtained earlier in this laboratory on another project.<sup>6</sup> If it is assumed that as the temperature decreases below 23°C the strain at the threshold of crazing continues to increase or at least does not decrease, then there will be some temperature below which the specimen will break before showing any crazing. If the strain increases more or less linearly with decrease in temperature, this point would be between -20 and 10°C for the general-purpose-grade materials and between 0 and 10°C for the heat-resistant-grade material.

While the data are insufficient to draw definite conclusions regarding the general trend for the strain at crazing at temperatures above 50°C, it appears that the strain at the threshold of crazing first decreases with increase in temperature, reaches a minimum, and then increases with further rise in temperature.<sup>7</sup> The minimum strain would be expected to occur at a higher temperature for the heat-resistant than for the general-purpose-grade materials. The assumption of an increase in the threshold crazing strain as the material approaches the rubbery stage is plausible because in the rubbery stage the material can be stretched very large amounts without showing any crazing.

The stress at the threshold of crazing, as can be seen in Fig. 3, decreases with increasing temperature very nearly at the same rate as the tensile strength; that is, the ratio of the threshold crazing stress to the maximum stress,  $\sigma_c/\sigma_{max}$ , remains fairly constant for all materials. The variation in this ratio appears to correlate very closely with the variation in strain at the onset of crazing.

A rather qualitative explanation of the temperature dependence of the threshold crazing stress may be made using a concept similar to that proposed by Maxwell and Rahm (1, 2). These authors suggest that a crazing crack starts at a region in which the general orientation of the polymer chains is normal to the applied tensile stress.<sup>8</sup> Similarly a crazing crack could start in a region in which portions of adjacent polymer chains are so oriented. Under sufficient stress the van der Waals' forces between segments of adjacent polymer molecules in this region are

<sup>6</sup> Unpublished report to the Office of the Quartermaster General.

<sup>7</sup> In an unpublished report of the Glass Division Research Laboratories, Pittsburgh Plate Glass Co., Pittsburgh, Pa., dated June 5, 1945, and prepared by Max M. Frocht, it was indicated that the crazing sensitivity of some commercial methacrylate samples appeared to have a maximum at about 150°F. We are indebted to this company for the loan of the above report.

<sup>8</sup> Hsiao and Sauer (6) suggest a mechanism of crazing based on orientation of domains of molecules—an idea that is somewhat similar to the concept of Maxwell and Rahm.

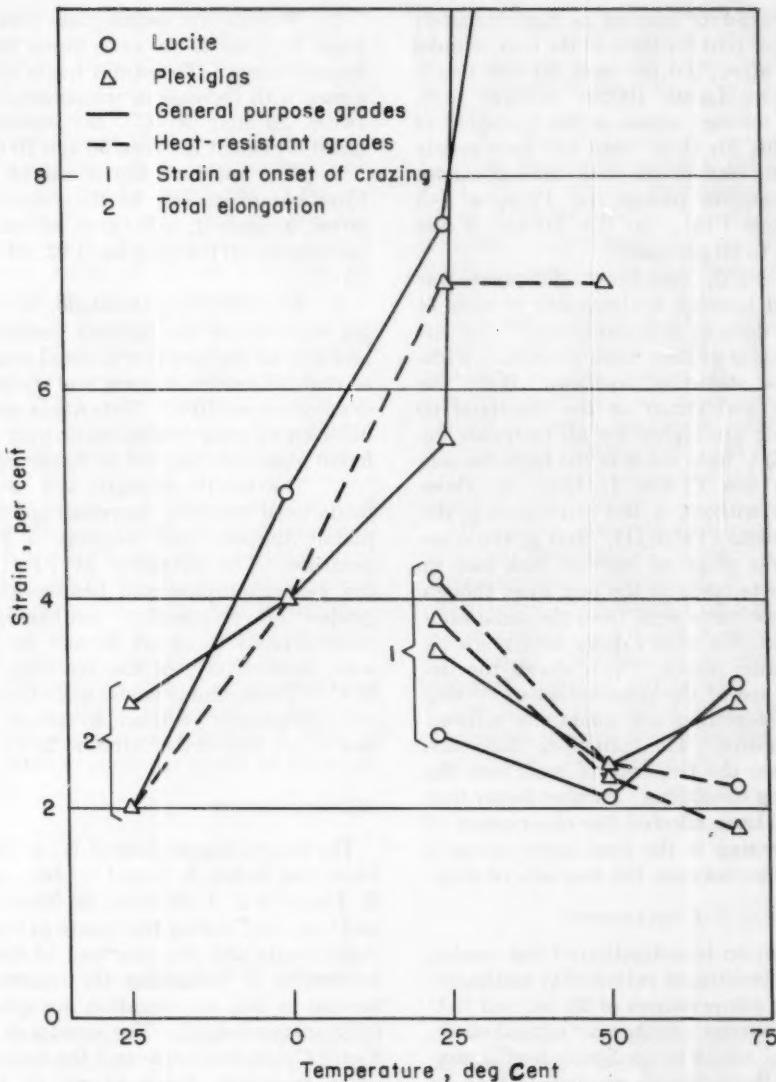


Fig. 6.—Variation of Strain at Onset of Crazing (Data from Fig. 5) and Total Elongation (Data from NBS Unpublished Report\*) with Temperature for Acrylic Plastics.

\* "Tensile properties of transparent plastics," April 14, 1950, NBS Reference 7.7/981c. Report to the Office of the Quartermaster General, Department of the Army.

overcome and a separation occurs. Such a separation occurs at the surface of the material rather than in the interior probably because surface irregularities result in stress concentrations at the surface. After forming, a crazing crack spreads until a region is reached in which the polymer chain segments are oriented predominantly parallel to the stress; the crack does not grow or grows slowly unless the material is strained further. As for the effect of temperature on the crazing, consider again the initiation of the crack. As the temperature is raised, the amplitude of thermal vibration of the chain segments is increased. Also the average distance between segments of neighboring chains is increased. Accordingly, with increasing temperature, less stress is required to cause the initial separa-

tion of portions of adjacent polymer molecules. Since crazing is the beginning of failure, it may then be expected that the ratio of the threshold crazing stress to the tensile strength should not vary much with temperature, as is found (Fig. 3).

In connection with another phase of the investigation of the crazing of acrylic material (7), data were obtained earlier at 23°C on the stress and strain at the threshold of crazing as well as on the tensile strength and total elongation of the same samples. In these experiments, the high-temperature box was not used; crazing was observed by viewing specimens against a dark background with north daylight, supplemented on dark days by fluorescent light. The data, which appear in Table II, indicate that the strain at the

threshold of crazing is approximately 2.5 per cent for three of the four samples and about 2.0 per cent for the fourth sample, Lucite HC201 (sample L1d). The average stress at the threshold of crazing for these tests was very nearly 85 per cent of the maximum stress for all samples except the Plexiglas I-A (sample P1a); for this sample, it was close to 90 per cent.

A highly significant difference was found between the two sets of tests at 23 C done at different times. This difference is evident from the tables without a statistical analysis. Both the stress and strain at the threshold of crazing are higher for all materials for the 23 C tests made in the high-temperature box (Table I) than for those made without a box surrounding the specimens (Table II); that is, the crazing was observed later in each case in the tests made in the box, even though the specimens were from the same samples and the observations were made by the same person. This shows the dependence of the observation of crazing on factors that are sometimes difficult to control. The principal difference between the two sets of tests was the lighting conditions. Another factor that might have affected the observation of the crazing is the time lapse—about 5 months—between the two sets of tests.

#### CONCLUSIONS

From an investigation of the crazing characteristics of polymethyl methacrylate at temperatures of 23, 50, and 70 C to determine whether a "critical-strain theory" might be applicable for this material, the following conclusions may be drawn:

1. Polymethyl methacrylate does not begin to craze at the same strain for all temperatures. The strain tends to decrease with increase in temperature between 23 and 50 C. No consistent trend is evident between 50 and 70 C.

2. The ratio of the stress at the threshold of crazing to the maximum stress, in general, is between 80 and 95 per cent for all the samples at 23, 50, and 70 C.

3. The observed threshold of crazing depends on the lighting conditions and also on the observer's visual acuity, so that the values of stress and strain at crazing are relative. Tests made under different lighting conditions or with different observers may not be comparable.

4. The tensile strength and secant modulus of elasticity decreases approximately linearly with increase in temperature. The strengths at 70 C of the general-purpose and heat-resistant grades of polymethyl methacrylate were reduced to about 30 and 50 per cent, respectively, of the strengths at 23 C. The modulus values at 70 C were correspondingly reduced to about 40 and 70 per cent of the values at 23 C.

#### Acknowledgment:

The helpful suggestions of W. F. Bartoe of the Rohm & Haas Co., Inc., and R. Leary of E. I. du Pont de Nemours and Co., Inc., during the course of these experiments and the courtesy of these companies in furnishing the materials for use in this investigation are gratefully acknowledged. The assistance of Victor Cohen who measured the second-order transition temperatures of the samples and of John Mandel who super-

vised the statistical analysis is appreciated.

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## Discussion of Paper on Flame Photometric Determination of Magnesium Oxide in Portland Cement<sup>1</sup>

DONALD P. SANDERS.<sup>2</sup>—Under the section entitled *Calibration of Apparatus*, the author made the statement, "The actual transmittance is 0.1 of the scale reading." Unless he has a reason which I have not considered, I believe that it may be best to omit this statement since it contributes nothing to the method that I can see and could cause some confusion. The transmittance on the scale of the main potentiometer

should be multiplied by 0.1 when the selector switch is in the "0.1" position only when the relative standard for 100 per cent has been used to balance the instrument with the switch set in the "Check" position or in the "1" position with the main potentiometer set at 100 per cent. Since the author uses a standard cement solution as his 100 per cent reference, and has made his initial adjustments for the 100 per cent setting while having the selector switch in the "0.1" position, then the various readings of his samples on the transmittance scale will be the true per cent transmittances *relative* to his chosen

standard 100 per cent *without* using the 0.1 factor. Of course the statement would be correct if he balanced his standard cement solution at the "0.1" switch position and set the transmittance scale at 100 per cent, and then said that his standard was actually 10 per cent. According to some persons' interpretations, the statement could be correct or incorrect, since it is such a relative thing. For this reason, I believe it would be best to omit this statement for the sake of clarity, unless the author has some reason which is not apparent to me.

The term "sensitivity" can be very

<sup>1</sup> T. C. Wilson and N. J. Krottinger, "Flame Photometric Determination of Magnesium Oxide in Portland Cement," *ASTM BULLETIN*, No. 189, April, 1953, p. 56 (TP 62).

<sup>2</sup> Chemist, Washington, D. C.

ambiguous when applied to the Model DU Spectrophotometer, unless it is clearly defined. To set the instrument for maximum sensitivity, one group of people would make those adjustments such that the galvanometer needle would give the greatest amount of deflection for a change of a given increment of the main potentiometer (such as varying the transmittance scale between 99 and 100 per cent and noting the amount of needle deflection). The other group of people would make those adjustments necessary to allow the instrument to be balanced at 100 per cent with the least amount of light falling on the photocell. This could be stated as being able to be balanced at 100 per cent with the darkest "blank" solution as possible, or by being able to use the most narrow slit width, or by being able to balance with the weakest concentration being used as a 100 per cent standard in flame photometry. The first group of people would set the switch to the "1" position, turn the sensitivity control full clockwise, and use the 2000 megohm phototube load resistor. The second group would set the switch at the "0.1" position, turn the

sensitivity control full counterclockwise, and switch to the 10,000 megohm phototube load resistor. When the spectrophotometer is set this way, the deflection of the galvanometer needle per unit change of the slide wire (main potentiometer) is at a minimum. So when we want "sensitivity," do we want to try to split hairs reading the value on the transmittance or optical density scales, or do we want the instrument to have enough response to be able to be balanced with a very low intensity of light falling on the photocell? Since the writer has seen people with both views, he thought it might be worth mentioning since the author specified that the phototube resistor switch should be set "in its most sensitive position." I would assume this to mean the 10,000 megohm position, since the 2000 megohm resistor is very seldom used for flame work unless a damping condenser is used in the 2532 tube plate circuit, and one is working with very high levels of emission.

Although we use the transmittance scale in flame photometry, does the author think some other term such as *emission* or *emittance* would be more appropriate?

If accepted usage is going to change, now is the time before the flame photometer is in widespread use and everyone is used to using "transmittance."

T. C. WILSON (*author's closure*).—

As Mr. Sanders points out, the statement, "The actual transmittance is 0.1 of the scale reading," could be interpreted with conflicting meanings, and is not essential to an understanding of the method.

Our statement that the phototube resistor switch should be set in its most sensitive position means the 10,000 megohm position. By maximum sensitivity we mean maximum meter deflection for a minimum of light energy. This condition is obtained at the 10,000 megohm switch position.

Mr. Sanders suggests that some term such as "emittance" should replace "transmittance" when applied to flame photometry. The Joint Committee on Nomenclature in Applied Spectroscopy has made considerable progress in standardizing the terminology. Their report No. 6 published August, 1952, in Analytical Chemistry, lists the term "emittance" as under study.

## Transitions in Teflon

BECAUSE Teflon (polytetrafluoroethylene) is highly resistant to chemical and thermal degradation, this plastic is proving useful in gaskets, washers, valve packings, etc. Where dimensional stability is required, however, consideration must be given to the transitions—always accompanied by sharp changes in volume—that occur between different polymorphic forms of this polymeric material with changes in temperature and pressure. In the course of a continuing study of the effect of pressure on high polymers, the National Bureau of Standards has found that Teflon is unique among all high polymers investigated to date in that it exists in three polymorphic forms within the range from 10 to 80°C at pressures between 1 and 10,000 atmospheres. Two different transitions between phases may occur at room temperature, depending on the pressure to which the specimen is subjected.

The Teflon specimen was immersed at different temperatures in a suitable pressure-transmitting liquid within the smooth bore of a thick-walled bomb of

hardened steel. Pressure was applied to the specimen by forcing a leakproof piston into the bomb. At intervals the depth of penetration of the piston and the corresponding hydrostatic pressure were measured. When pressure was plotted against piston position (an indication of the extent of volume change) the transitions between polymorphic forms appeared as discontinuities in the curve.

Teflon "melts" at 330°C, passing from a crystalline to an amorphous phase. The first transition at atmospheric pressure takes place at about 20°C and involves approximately a 1 per cent change in volume. This transition, which is reversible and involves a change in the X-ray diffraction pattern, is not a simple effect but a complex transition appearing to consist of two overlapping volume discontinuities, one centered at 20°C and the other at 30°C. The second transition, at 5500 atmospheres, takes place at 25.5°C and involves a volume change of about 2.5 per cent.

On a pressure-temperature chart, or phase diagram, the two room-temperature transitions are points on two different transition lines which, together

with a third transition line, intersect in a triple point and form the boundaries between three polymorphic forms designated phases I, II, and III. The room-temperature transition at atmospheric pressure is the beginning of a transition line between phases I and II which proceeds to higher pressure at an accelerating rate with increasing temperature and finally terminates in the triple point at about 70°C. At higher pressures the volume change associated with this transition line decreases rapidly to a very small value. The transition line between phases II and III leaves the triple point with negative slope, proceeding toward lower temperatures and higher pressures and ultimately passing through the high-pressure room-temperature transition point previously observed at 5500 atmospheres.

The third transition line, between phases I and III, passes from the triple point to higher pressures with increasing temperatures. Within the region studied, this transition line is also accompanied by a volume change of about 2.5 per cent.

### Fatigue and Fracture of Metals

A Symposium Held at the Massachusetts Institute of Technology—June 19–22, 1950

THE title of this symposium might possibly be considered somewhat enigmatic in that the meaning of "and Fracture" is not immediately obvious. Since "Fatigue" usually is understood to embrace all the effects resulting from cyclic loading, including fracture, one might assume that "and Fracture" indicates that types of fracture other than fatigue fractures are to be considered. Examination of the contents reveals that this is indeed true. Apparently the purpose of the symposium was to discuss both brittle fracture of metals, as exemplified in the welded ship failures, and the fatigue of metals. It could not reasonably be expected that comprehensive coverage of two such broad subjects could be attained in this single volume. The merits of the book, therefore, can be found in the outstanding quality of several of the individual papers.

The subject of fatigue predominates, with nine of the fourteen papers dealing almost exclusively with fatigue. Two papers deal with brittle fracture almost exclusively, while the remaining three papers are concerned both with fatigue and brittle fracture in varying degrees.

One of the most outstanding papers presented in the MIT symposium is an excellent summary of "The Fatigue Problem in Airplane Structures" by Dryden, Rhode, and Kuhn of the National Advisory Committee for Aeronautics. The authors point out that only recently has fatigue emerged as a design problem in airframes, but it is assuming continually increasing importance. One of the problems to be met is the determination of the stress spectrum to which the structure is actually subjected in flight, especially with respect to those stresses resulting from gust loads. Since these loads will vary in intensity, the problem of cumulative damage is of prime importance. The attack on these problems by the NACA is discussed. In close relation to this paper, is "A Review of Cumulative Damage in Fatigue," by N. M. Newmark in which the present knowledge on cumulative damage is reviewed.

R. E. Peterson discusses "Brittle Fracture and Fatigue in Machinery," in a paper almost wholly devoted to fatigue and rightly so, since by far the great majority of failures in machinery result from fatigue. Considerations involved in design are discussed with consider-

able emphasis on methods of handling stress concentration problems. An ingenious three-dimensional model that can be disassembled was developed for illustrating the design relationships for axial loading.

In "Brittle Fracture and Fatigue in Ships," Dr. Finn Jonassen points out that examination of actual fractured ship plates leads to the conclusion that fatigue has not played a major role in welded ship failures. The possibility exists, however, that cracks could initiate as a result of fatigue and later undergo extensive propagation under static loading. Some of the research work on the ship plate problem is reviewed and some of the measures adopted to minimize the hazard of brittle failures in ships are discussed.

"The Fundamentals of Brittle Behavior" are treated at some length by Dr. E. Orowan. He shows how the Griffith analysis of the fracture of brittle solids can be modified to apply to the "brittle" fracture of metals in which fracturing is accompanied by some plastic deformation even in instances where very little over-all ductility is observed. In addition to the increase of surface energy resulting from fracture, a term is included for the work associated with plastic deformation along the fracture surface. The approach suggested by Orowan is actually very similar to that advanced earlier by Dr. G. Irwin and associates at the Naval Research Laboratory.

Other papers include: "General Survey of the Problem of Fatigue and Fracture" by M. Gensamer; "Internal Stresses and Fatigue" by O. J. Horger and H. R. Neifert; "Designing for Fatigue" by R. L. Templin; "The Statistical Aspect of Fatigue Failures and Its Consequences" by W. Weibull; "Significance of Transition Temperature in Fatigue" by C. W. MacGregor; "The Influence of Metallographic Structure on Fatigue" by P. L. Teed; "Fatigue at Elevated Temperatures" by N. J. Grant; "The Techniques of Physical Metallurgy for Studying Fatigue Damage" by J. T. Norton; and "Experimental Study on Temper Brittleness of Slightly Alloyed Carbon Steel" by P. A. Jacquet and A. R. Weill.

In summary, this book is a valuable contribution, not so much because of a complete appraisal of existing knowledge, but rather because of the excellent individual papers dealing with various specific aspects of fatigue and fracture problems.

W. T. LANKFORD

### Tool Engineers' Data Book

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### Heating, Ventilating, and Air Conditioning Guide 1953

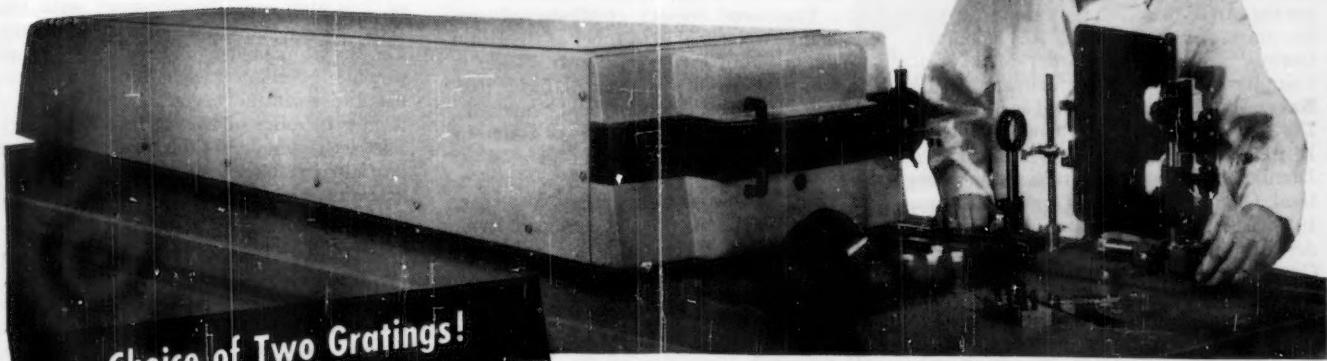
THE 1953 edition of *The Heating, Ventilating, and Air Conditioning Guide*, published annually by the American Society of Heating and Ventilating Engineers, has just been issued.

This latest edition has been expanded to include a chapter on water vapor and condensation in building construction. This section reviews principles, data, testing, and computing vapor transmission through materials. Several chapters have been thoroughly revised and many additions have been made throughout the text. The 31st edition of 1560 pages, is priced at \$7.50.

Copies may be obtained at the American Society of Heating and Ventilating Engineers, 62 Worth St., New York 13, N. Y.

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# PERSONALS...

News items concerning the activities of our members will be welcomed for inclusion in this column.

NOTE—These "Personals" are arranged in order of alphabetical sequence of the names. Frequently two or more members may be referred to in the same note, in which case the first one named is used as a key letter. It is believed that this arrangement will facilitate reference to the news about members.

At the recent annual meeting of the American Foundrymen's Society the following ASTM'ers were elected directors for three-year terms: **E. C. Hoenicke**, General Manager, Eaton Mfg. Co., Foundry Div., Detroit, Mich.; **C. V. Nass**, Vice-President, Beardsley & Piper Div., Pettibone Mulliken Corp., Chicago, Ill.; **G. Ewing Tait**, Manager of Foundries, Dominion Engineering Works, Ltd., Montreal, Quebec, Canada. Three of the four 1953 AFA Medalists also are active in ASTM work. **William J. Grede**, President, Grede Industries, Inc., Milwaukee, Wis., received the William H. McFadden Gold Medal "for outstanding public service bringing great credit upon and broad recognition for the entire foundry industry." **Daniel E. Krause**, Executive Director, Gray Iron Research Institute, Columbus, Ohio, was awarded the John H. Whiting Gold Medal "for outstanding contributions to AFS and the foundry industry in the field of ferrous metallurgy and research." **William Romanoff**, Vice-President, H. Kramer & Co., Chicago, Ill., received the Joseph S. Seaman Gold Medal "for exceptional contributions to AFS and its Brass and Bronze Division over many years."

**Edward J. Albert**, President, Thwing-Albert Instrument Co., Philadelphia, Pa., and very active in ASTM work, was elected President of the Scientific Apparatus Makers of America at their late May meeting in White Sulphur Springs. He was President *pro tem* of SAMA for the past few years, and the new office recognizes his outstanding work for this trade association. He has been particularly active in the Industrial Instrument Section. In addition to his ASTM, SAMA, and other work Mr. Albert is interested in the work of the Technical Association of the Pulp and Paper Industry. He was a founder member of TAPPI's Delaware Section, which group recently instituted an Edward J. Albert Award, given annually to the author of the outstanding paper presented at the May meeting, and recognizing also manner of presentation. In ASTM Mr. Albert has been a member for many years of Committee D-6 on Paper and Paper Products, also serves on Committees D-1 on Paint, D-9 on Electrical Insulating Materials, D-13 on Textiles, and E-1 on Methods of Testing. He is Past-Chairman and active member of the Philadelphia District Council.

**M. D. Baker**, Chief Chemist, West Penn Power Co., Springdale, Pa., is Chair-

man of the Program Committee of the Fourteenth Annual Water Conference of the Engineers' Society of Western Pennsylvania, to be held in October at the Hotel William Penn, Pittsburgh. Mr. Baker is a former Secretary of the ASTM Pittsburgh District Council, and currently Chairman of this group, also is active in technical work of the Society.

**Tom Barlow** is now Sales Manager, International Minerals & Chemical Corp., Eastern Clay Products Dept., Chicago, Ill. He was formerly with the Eastern Clay Products plant in Jackson, Ohio.

**B. D. Beamish** has sold his interest in Honeycomb Company of America, Inc., Mt. Vernon, N. Y., and is now in business as a designer of relay operated pneumatic machines.

**Alfred P. S. Bellis**, former Chief Electrical Engineer of the John A. Roebling's Sons Corp., Trenton, N. J., was one of ten alumni of Lehigh University (Bethlehem, Pa.) to receive awards from the University for distinguished personal achievement and public service. Mr. Bellis, whose citation noted that he attained national recognition in his improvements of armored cable and technical service to the Government and industry, was honored by ASTM with an Award of Merit in 1950, in recognition of valued contributions to the technical work of the Society for 40 years, particularly in Committee B-1 on Wires for Electrical Conductors.

**William Blum**, retired Chemist, National Bureau of Standards, Washington, D. C., received the honorary degree of Doctor of Science from the University of Pennsylvania at its 197th Commencement on the campus in Philadelphia on June 10. The honor came just 50 years after Dr. Blum's graduation from the University in 1903 with the degree of bachelor of science in chemistry. The recipient of a number of awards and medals, Dr. Blum was given an ASTM Award of Merit in 1951, in recognition of pioneering work in the field of electrodeposited metallic coatings.

**T. A. Boyd**, Research Consultant, Research Laboratories Div., General Motors Corp., Detroit, Mich., and ASTM Past-President, received the honorary degree of Doctor of Science at the commencement exercises of Ohio State University in June. A long-time member of ASTM, Mr. Boyd has served as Chairman of Committee D-

2 on Petroleum Products and Lubricants for 15 years; was elected to honorary membership in that group in 1952, and continues as an active member of D-2 Advisory Committee. Mr. Boyd also is a Past-Chairman of the Detroit District Council, and currently serves on the Administrative Committee on Research.

**Frank G. Breyer**, a partner of Singmaster & Breyer, Metallurgists and Chemical Engineers, New York City, received an honorary degree of Doctor of Engineering from Clarkson College of Technology (Potsdam, N. Y.) at the commencement exercises of the class of 1953 in late May. For many years Chief of Research and Development with the New Jersey Zinc Co. of Pennsylvania, Dr. Breyer is holder of some 50 American patents. Affiliated with numerous technical and scientific organizations, he is a former member of the ASTM New York District Council, and for many years has participated in the work of Committee D-1 on Paint, and other technical groups of the Society.

**H. H. Britton** is now Assistant Director for Engineering Standards and Criteria, Office of Director of Installations, Office of the Secretary of Defense, Washington, D. C. He was formerly Structural Engineer, National Production Authority.

**Walter F. Collins**, for many years Engineer of Tests, has been named Assistant Chief, Engineering Services, New York Central System, New York City.

**Victor Conquest**, Vice-President in Charge of Research and Development, Armour and Co., Chicago, Ill., received the 1953 Nicholas Appert Medal at the Annual Meeting of the Institute of Food Technologists in June. The medal is awarded annually to a food technologist who has fostered the improvement of foods through research or better production methods. Dr. Conquest guided the development of sugar-free dried eggs.

**George Demitrack** has accepted a position as Chemical Engineer, Picatinny Arsenal, Dover, N. J., following completion of graduate studies at Columbia University.

**Adolf C. Elm**, Technical Director, Standard-Toch Chemicals, Inc., Staten Island, N. Y., has been selected to present the fifth Joseph J. Mattiello Lecture at the 1953 annual meeting of the Federation of Paint and Varnish Production Clubs to be held in Atlantic City in October.

**Fred N. Finn**, until recently Lieutenant with the U. S. Department of the Navy, San Diego, is now Assistant Research Engineer, Institute of Transportation and Traffic Engineering, University of California at Berkeley.

**George Flanagan**, who had been loaned to the Plastics Section of NPA by B. F. Goodrich Chemical Co., has served his term in that capacity and will now become Goodrich's representative in Washington, D. C.

(Continued on page 78)

## Kodak reports to laboratories on:

a new projector for detailed study of 16mm movies . . . identifying solids by refractive index . . . speeding inspection of electron tube assemblies . . . the mitigation of office drudgery

### "Analyst" projector

This is for those who use 16mm movies for dispassionate purposes: the analysis of cavitation, of the motion of cilia, of malfunction in a tapping machine, of a girl assembling a cigarette lighter, of a sophomore's performance at tackle, and so on through the myriad of applications of high speed and normal speed cinematography.

We now offer the Kodascope Analyst Projector for the minute study of silent 16mm film footage. It is specifically designed to be reversed and rerun all day long without a hitch, without overheating, and without blanking out at the instant of reversing. The blower fan keeps on blowing whether the film is moving or not because it is on a separate motor. Built right into the carrying case is the Kodak Daylight Projection Viewer. There is no need to turn the room lights off or pull down the shades and no need for a bulky screen. The reversing switch is on the end of a 5-foot cord for the benefit of a projectionist too excited to sit still.

For a demonstration of the Kodak Analyst Projector, see a Kodak Industrial or Audio-Visual Dealer. Write Eastman Kodak Company, Cine-Kodak Sales Division, Rochester 4, N. Y., if you don't know where to find one. The machine currently lists at \$295.

### Refractive index liquids

In this day of polarography, x-ray spectrography, infrared spectrophotometry, mass spectrometry, nuclear magnetic resonance, etc., it may be considered primitive (among the excessively sophisticated) to identify a solid compound by immersing it in a liquid of matching refractive index to make it disappear without dissolving. We think it is not primitive at all but even elegant, in the scientific sense. On page 214 of the current catalog of Eastman Organic Chemicals there appears a list of 39 organic liquids with their refractive indices, ranging from Methanol at  $n_{D}^{20}=1.3289 \pm .0005$  to Diiodomethane at 1.7400. If you order them in lots of 10 or more, we can supply them in 25-cc glass-stoppered bottles. Since most

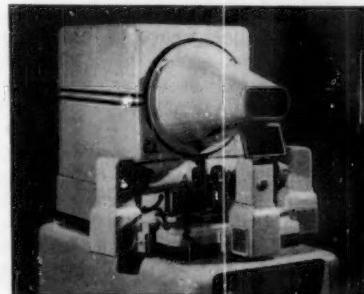
of them are priced at 60¢ each in this size, you and we can, for as little as \$6 plus postage, work out a deal on a set.

If you don't have a copy of "Eastman Organic Chemicals, List No. 38" from which to make your selection, write Eastman Organic Chemicals Department, Distillation Products Industries, Rochester 3, N. Y. (Division of Eastman Kodak Company).



### Tube inspection

We want to make sure that everybody interested in the manufacture of electron tubes knows about this machine. It permits the gals who inspect tube assemblies to do their inspection in comfort at high magnification. All they have to do is look into the box to see any part of the assembly magnified 20 times. It isn't just a shadow the gal sees either, but the actual surface appearance. As she rotates the tube assembly on the fixture, she can in a matter of a few seconds check grid and cathode spacing and uniformity, and the condition of the various welds. With-



out refocusing, she can come down to 10X and a wider field of view by means of the gearshift-like lever at the left. A handwheel at her right hand brings different planes of the assembly into focus. A picture of ease she sits, and so she should be, if her eyesight and alertness are to play fair with the finished product rejection rate and the firm's quality reputation.

This is a special tube-inspection version of the Kodak Contour Projector. Quotation and full details from Eastman Kodak Company, Special Products Sales Division, Rochester 4, N. Y. Kodak Contour Projectors also do a fine job for those whose minds these days are on transistors instead of subminiature tubes.

### Verifax copying



This young lady is demonstrating the new, revolutionary, and unique Verifax Printer, a form of salvation from drudgery for millions of her typewriter-pounding sisters, including the one who works for you. Surely her time can be more profitably used than in copying reports, letters, cards, charts, etc., when a ready-to-use Verifax copy can be made in a total elapsed time of 50 seconds, additional copies a few seconds apart from a single sensitized sheet. That sheet is a rather fundamental new development from the Kodak Research Laboratories. Roomlight-handling, it incorporates its own developer and dye-former. After reflex exposure within the machine, this sheet is "floated" into a built-in tray of activator. The whole sheet blackens in a few seconds, but wherever white space on the original document resulted in light exposure, the more vigorous development reaction releases a product which locally hardens the gelatin. The unhardened areas, representing what was dark on the original document, are now left soft and black and readily transferable to unsensitized paper pressed with it through a roller on the unit. If your young lady appreciates such niceties of physical chemistry—congratulations! But even if she doesn't, the copies will be just as good and still cost less than five cents apiece for three made from one matrix.

The Verifax Printer will sell for \$240. If you'll write to Eastman Kodak Company, Industrial Photographic Division, Rochester 4, N. Y., we'll arrange for a demonstration, as equipment becomes available in your locality.

All prices quoted are subject to change without notice.

This is one of a series of reports on the many products and services with which the Eastman Kodak Company and its divisions are . . . serving laboratories everywhere

Kodak

(Continued from page 76)

**Alexander Frieden** has been elected Vice-President of Research at Pabst Brewing Co., Milwaukee, Wis. He had been Director of Research.

**Truman S. Fuller** has been appointed Consultant for the Research and Metallurgical Departments of Heppenstall Co., Pittsburgh steel forgings manufacturer. Mr. Fuller, who recently retired after 42 years of service for the General Electric Co., at Schenectady, N. Y., is Past-President (1951-1952) of ASTM and continues as a member of the Board of Directors of the Society until 1955.

**F. M. Galloway**, formerly Technical Superintendent, has been elected Vice-President in Charge of Research and Development at Quaker Rubber Corp., Pittsburgh, Pa.

**Frank X. Gilg** has been appointed an Executive Assistant in the Boiler Division of The Babcock & Wilcox Co., New York City. He has been with B&W since 1922 in various capacities. Mr. Gilg is the author of several papers and technical articles on boilers, stokers, and bagasse furnaces and holds various patents. In 1951 he was loaned to the National Production Authority in Washington where he served as Chief of the Boiler Section of the Power Equipment Division, assisting in the allocation of scarce materials to boiler manufacturers. Mr. Gilg is active on the Boiler Code Committee of ASME, and was leader of the American delegation of boiler manufacturers and engineers attending the international conference in Paris in May, 1953, to develop an international boiler code.

**L. N. Gushard**, formerly with the Viking Pump Co., Cedar Falls, Iowa, is now associated with the Tokyo District Office of the Japan Procurement Agency.

**Robert L. Hahn**, until recently with Jones-Hettelsater Construction Co., Kansas City, Mo., has accepted a position as Chief Engineer with E. R. Haynes, General Contractor, Spokane, Wash.

**Gunter Hermann**, formerly Technical Manager, Cristais Prado, Ltda., Sao Paulo, Brazil, is now associated with Wheaton do Brasil S. A. in the same city.

**A. E. Horn**, President of the A. C. Horn Co., Long Island City, N. Y., and Vice-President of Horn's parent firm, the Sun Chemical Corp., retired March 31. A member of many technical organizations, Mr. Horn has been affiliated with ASTM since 1910, participating in the activities of Committee D-1 on Paint. A man of varied interests and talents, Mr. Horn has been a reporter and a teacher of science in addition to a paint executive. He has published articles on kites, their origin and history, and received recognition from the French for his contributions to the waterproofing of the Maginot line.

**J. F. B. Jackson**, who has been Director of Research to the British Steel Founders' Assn. since the formation of its Research and Development Div. in 1949, has been

appointed Director of the recently formed British Steel Castings Research Assn.

**Melvin W. Jackson**, for some time on the faculty of the University of Colorado, Department of Civil Engineering, has opened his own office as Consulting Engineer in Boulder, Colo.

**Wharton Jackson**, formerly with the Georgia Kaolin Co., Elizabeth, N. J., has established his own business at 714 W. Olympic Blvd., Los Angeles, Calif. Mr. Jackson has been active in ASTM Committee C-21 on Ceramic Whitewares for several years.

**Stanley J. Johnson** has been appointed Chief Engineer of Greer & McClelland, Consulting Foundation Engineers of Houston, Tex., and Montclair, N. J. Mr. Johnson will be stationed at the Montclair office. Since 1944, Mr. Johnson has been with the Waterways Experiment Station, Corps of Engineers, Vicksburg, Miss., where more recently he has been Chief of the Embankment and Foundation Branch. During 1951 he was in charge of foundation investigations for the Savannah River Plant for the Atomic Energy Commission and E. I. du Pont de Nemours & Co. Mr. Johnson has been active for many years in ASTM Committee D-18 on Soils for Engineering Purposes and certain of its subgroups.

**Harry E. Jordan**, Secretary of the American Water Works Assn., has been awarded the Fuller Award for this year by the Association's New York Section. Mr. Jordan is a past-president and honorary member of the AWWA.

**Shigeo Kase** has been promoted to Chief Researcher in charge of both physical and mechanical improvement at Togawa Rubber Manufactory, Osaka, Japan. Mr. Kase, who is one of our some 16 ASTM members in his country, is taking an active part in testing and research in his field.

**Robert M. Kemper, Jr.**, until recently Corporal with the U. S. Department of the Army, at Tullahoma, Tenn., is now associated with Ebasco Services, Inc., Columbus, Ohio, as Office Engineer.

**Charles F. Kettering**, Director and Consultant, General Motors Corp., Detroit, Mich., received the 1953 Award of the National Society of Professional Engineers, granted on the basis of meritorious service to the engineering profession.

**Cyril S. Kimball** has been promoted from the position of Vice-President to Executive Vice-President of Foster D. Snell, Inc., New York City. He has been with the Snell Corporation since 1926. Active in the field of chemical specialties products including odorless quick-drying paints and new types of wax products, Mr. Kimball is affiliated with many technical groups. In ASTM he is a member of Committees D-13 on Textile Materials, and D-21 on Wax Polishes and Related Material.

**Harry Knecht**, Mechanical Plant Engineer, Consolidated Edison Co., New York City, has been elected Chairman of the Executive Committee of the Metropolitan Section of The American Society of Mechanical Engineers.

**Chris Kurzwell**, formerly Plant Manager, Chicago Show Printing Co., Chicago, Ill., is now President, American Tape Co., Port Huron, Mich.

**Robert G. Larsen**, Head, Lubricants and Fuels Dept., Shell Development Co., Emeryville, Calif., is on a two-year assignment as Director of Research at Shell Oil Co.'s Martinez (Calif.) refinery.

**Harvey C. Lee** has been elected a director of Basic Refractories, Inc., Cleveland, Ohio. Mr. Lee joined Basic in 1926 and has been a Vice-President since 1945. He has also been in charge of the Technical Department of Basic Magnesium, Inc., a subsidiary, and Director of Research for Basic Refractories.

**John M. Lessells** has retired as Associate Professor of Mechanical Engineering, Massachusetts Institute of Technology. He will serve the Department of Mechanical Engineering next Fall as part-time lecturer with the title of Emeritus Associate Professor. During 1943, 1944, and 1945 Professor Lessells was on leave of absence for work with the British Ministry of Supply Mission to the United States for consulting work on tank engines and parts. Affiliated with ASTM since 1924, he has rendered important service on Committees E-1 on Methods of Testing, and E-9 on Fatigue.

**James J. Lingane**, Professor of Chemistry at Harvard University, was the 27th Annual Priestley Lecturer at Pennsylvania State College, his lecture being on the subject "Innovations in Electroanalytical Chemistry."

**Jesse Talbot Littleton**, Vice-President and former Director of Research of Corning Glass Works, has been named an honorary member of The American Ceramic Society.

**Donald H. Loughridge**, nationally known physicist and until recently the Atomic Energy Commission's Assistant Director for Reactor Development, has been named Dean of Northwestern University's Technological Institute. A specialist in the fields of nuclear physics and cosmic rays, Dr. Loughridge was principal physicist in the National Bureau of Standards 1941-1942, and project leader for the Manhattan project at the University of California 1942-1943. During 1944-1945 he was chief of the operational analysis section, United States Air Force, in Guam, England, and Italy. A graduate of the California Institute of Technology, he taught physics for two years at the University of Southern California, and was on the faculty of the University of Washington 1931-1948. Dr. Loughridge succeeds Ovid W. Eshbach who had served as Dean of the Institute since its establishment in 1939, and who now

(Continued on page 80)

# ASTM Fuel Oil Tests

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PENSKY-MARTENS CLOSED CUP TESTERS

For greater convenience and safety in determining fuel-oil flash points as described in ASTM designation D 93, the Pensky-Martens Closed Cup Tester has been re-designed by Fisher engineers.

The heater is now an integral part of the standard assembly which makes it easier to move from one spot to another. The newly designed cup is carefully machined to ASTM specifications and is a forging to withstand thermal shock more efficiently . . . cannot tip when set on laboratory bench.

There are two models, one heated with gas and the other with electricity. Both models are available with electric motors, connected to the propeller of the stirrer through a flexible shaft . . . and both models have the intricate "eccentric cam" assembly for dipping the test flame at the exact time the shutter opens.



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(Continued from page 78)  
plans to devote his time to a study of teaching.

**Francis J. Lowey**, formerly Assistant Chief Engineer, The S. K. Wellman Co., Bedford, Ohio, is now President, Metallic Friction Material Co., Cleveland.

**James T. MacKenzie**, Technical Director, American Cast Iron Pipe Co., Birmingham, Ala., and President, Foundry Educational Foundation, was elected Vice-President of the National Castings Council.

**George G. Manov**, since 1949 Chief Adviser, Field Service Branch, Isotopes Division, U. S. Atomic Energy Commission at Oak Ridge, Tenn., has been transferred to the AEC Office of Industrial Development, Washington, D. C. His principal task in his recent assignment is to help promote the industrial, nonmilitary applications of atomic energy, including the development of electric power from atomic energy. Dr. Manov is Honorary Chairman of ASTM Committee E-10 on Radioactive Isotopes.

**Herman Mark**, Head of the Division of Polymer Chemistry, Polytechnic Institute of Brooklyn, received the 1953 Honor Scroll of the New York Chapter of the American Institute of Chemists for his researches in polymers and other work. His citation read: "As scholar and humanitarian, teacher, and expositor, scientist and researcher, you have given lavishly to young and old throughout the world. Beloved by students and colleagues, your adopted country proudly acclaims you for the distinction you have brought." Dr. Mark also has recently been awarded an honorary Ph.D. from the University of Uppsala, Sweden.

**S. C. Massari** has resigned as technical Director of the American Foundrymen's Society to assume the position of General Manager of the Foundry Division, Hansell-Ecock Co., Chicago, Ill.

**John K. McIver**, formerly with the Commercial Controls Corp., Rochester, N. Y., is now associated with G. H. Leland, Inc., Dayton, Ohio, in the capacity of Senior Metallurgist.

**Paul A. Metzger** has been appointed to the newly created position of Materials Manager at Servel, Inc., Evansville, Ind. He will supervise and coordinate Servel material control, production control, shipping, expediting, materials warehousing, and schedule planning.

**Herbert F. Moore**, University of Illinois Research Professor Emeritus in theoretical and applied mechanics, and Past-President and Honorary Member of ASTM, was honored by his alma mater, the University of New Hampshire, receiving the New Hampshire Alumni citation for his achievements and for his contributions to society.

**J. J. Mulvey**, Manager of Domestic Fuel Oil Marketing for the Atlantic Refining Co., Philadelphia, Pa., retired recently after a career of 41 years with the company. A member of the American

Petroleum Institute, Mr. Mulvey has served for many years on Technical Committee E on Burner Fuel Oils of ASTM Committee D-2 on Petroleum Products and Lubricants.

**William F. Murdock**, formerly General Manager, The Eagle-Picher Co., East Chicago, Ind., is now President, Murdock Lead Products Co., Dallas, Tex.

**George G. Oberfell**, retired Vice-President in Charge of Research and Development, Phillips Petroleum Co., Bartlesville, Okla., was one of six honorees who received "Grand Old Man" awards in each of six divisions of the oil industry at the International Petroleum Exposition in Tulsa, Okla., in May. Dr. Oberfell in his earlier years was very active in ASTM Committee D-2 on Petroleum Products and Lubricants, and was elected to honorary membership in that group in 1951.

**John C. Oliver**, City Engineer of Vancouver, B. C., Canada, has been elected President of the British Columbia Association of Professional Engineers.

**Jorj O. Osterberg** has been promoted to Professor of Civil Engineering, Technological Institute, Northwestern University, Evanston, Ill. Dr. Osterberg is author of numerous articles on soil mechanics and foundation engineering.

**Emil Ott**, Director of Research, Hercules Powder Co., Wilmington, Del., has been elected President of the American section of the Société de Chimie Industrielle. A graduate of the Swiss Institute at Zurich, Dr. Ott was a professor at Johns Hopkins University until joining Hercules 20 years ago.

**G. A. Perley**, Associate Director of Research, Leeds & Northrup Co., Philadelphia, Pa., has been awarded the Alumni Citation for Outstanding Achievement and Service in the Field of Chemistry by his alma mater, the University of New Hampshire.

**Walter H. Prahl** has been elected a Vice-President of Durez Plastics and Chemicals, Inc., North Tonawanda, N. Y. Dr. Prahl is from Heidelberg, and is inventor of the Raschig process for the synthesis of phenol from benzene.

**Leonard E. Ravich**, formerly Director of Research, Vat Craft Corp., is now Vice-President, Solid State Research Institute, New York City.

**Raymond C. Reese**, Structural Engineer, Toledo, Ohio, received the 1953 Award of the Concrete Reinforcing Steel Institute "for his contributions to reinforced concrete construction through design," presentation being made at the Institute's 29th Annual Meeting in April. Mr. Reese is co-author of "Introduction to Reinforced Concrete Design" and author of the "C.R.S.I. Design Handbook."

**James K. Rice**, Vice-President of Cyrus William Rice & Co., Industrial Water Consultants, Pittsburgh, Pa. was among 100 young men honored by Time Magazine and the Pittsburgh Chamber of Commerce at a

dinner on Thursday, June 18, 1953. These young men having been selected by a group of 25 prominent Pittsburgh educators, religious, scientific, and industrial leaders on the basis of performance in their chosen field as an indication of their promise as leaders of the future. In ASTM, Mr. Rice is an active participant in the work of Committee D-19 on Industrial Water.

**R. M. Rogers**, formerly associated with Thompson Products, Inc., West Coast Plant in Bell, Calif., is now Chief Engineer, B. H. Hadley Co., Pomona, Calif.

**W. E. Santoro**, Head, Research Div., The Monroe Sander Corp., Long Island City, N. Y., has been elected President of the New York Paint & Varnish Production Club for the 1953-1954 term.

**Robert W. Savidge**, for many years Chief Chemist, Union Pacific Railroad Co., Omaha, Neb., retired May 1. He is now residing at 1372 Inspiration Dr., La Jolla, Calif.

**Frederic D. Schottland** has been named Chief Production Engineer, Fairchild Camera and Instrument Corp., Potentiometer Div., Hicksville, L. I., N. Y.

**Charles M. Schwartz** has been named to supervise a research group engaged in X-ray and electron diffraction and electron and light microscopy studies at Battelle Memorial Institute, Columbus, Ohio. A member of the Institute staff for the past 13 years, Dr. Schwartz has long been associated with X-ray and electron diffraction work. In ASTM he participates in the work of Committee E-4 on Metallography.

**G. B. Seaborn**, until recently with Falk and Co., Minneapolis, Minn., is now Plant Manager, Cargill, Inc., of the same city.

**Marvin R. Spindler**, until recently Supervisor, Paint Lab. Unit, U. S. Bureau of Reclamation, Denver, Colo., has accepted an appointment as Technical Director, Techkote Co., Inc., Inglewood, Calif.

**N. T. Stadtfeld** has retired after many years of service as Division Engineer, Board of Water Supply, City of New York.

**Frank G. Steinebach**, Editor, *Foundry*, has been elected Secretary of the National Castings Council.

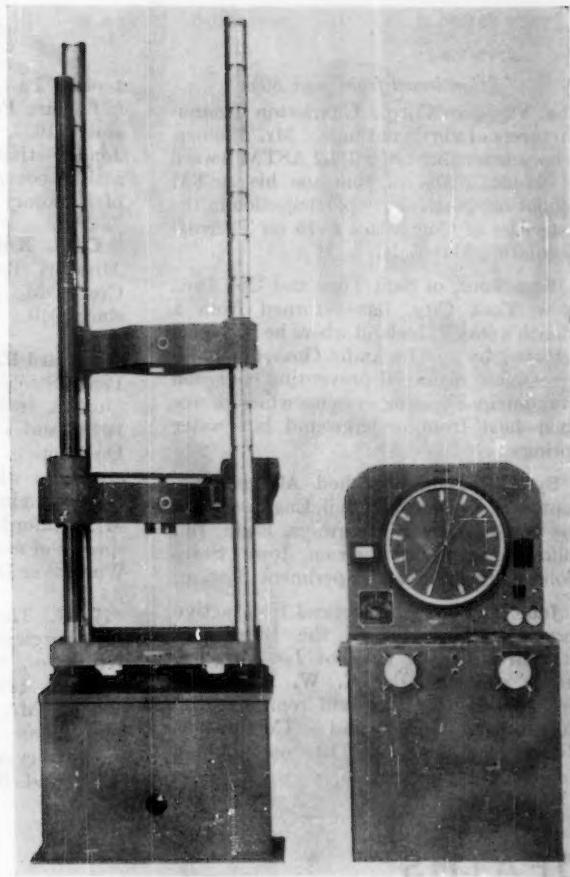
**Sydney H. Stilley**, formerly Project Manager and Chief Engineer with Lieb Bros., Inc., has established his own office as Consulting Engineer in Jacksonville, Fla.

**Steven M. Swain**, Director of Research, North American Refractories Co., Cleveland, Ohio, was elected a Vice-President of The American Ceramic Society.

**Ray Thomas**, for many years Staff Engineer, Carbide and Carbon Chemicals Co., Div. of Union Carbide and Carbon Corp., South Charleston, W. Va., has taken an early retirement from the company to assume new duties as Executive Vice-President and General Manager of

(Continued on page 82)

# Now! THE Finest IN TESTING AT LOWEST COST



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(Continued from page 80)

the Vimasco Corp., Charleston (manufacturers of vinyl coatings). Mr. Thomas, who was recipient of a 1952 ASTM Award of Merit, plans to continue his ASTM affiliation, particularly participation in the activities of Committee C-16 on Thermal Insulating Materials.

**Sam Tour**, of Sam Tour and Co., Inc., New York City, has returned from a month's stay in Iceland where he had been retained by the Icelandic Government to investigate means of preventing corrosion in municipal heating systems which derive their heat from underground hot water springs.

**Syed Rafiuddin Wahed Ally** has accepted a position as Civil Engineer with the Illinois Div. of Highways, Elgin, Ill., following graduation from Iowa State College, Engineering Experiment Station.

**John T. Young** has retired from active service as Director of the Bureau of Standards of the City of Los Angeles. He is succeeded by **C. W. Beardsley**, Acting Director, who will represent the Bureau in the Society and on Committees C-4 on Clay Pipe and D-18 on Soils for Engineering Purposes.

toona, Pa.), and Consulting Engineer (Malvern, Pa.) (June 7, 1953). Member since 1937. (An appreciation of Mr. Jones' activities appears on page 13 in the article covering the posthumous award of Honorary Membership.)

**C. J. Knickerbocker**, Superintendent, Missouri Portland Cement Co., Sugar Creek, Mo. (May 23, 1953). Member since 1940.

**Edward R. Sanford**, Chief Metallurgist, Penn Steel Castings Co., Chester, Pa. (June 6, 1953). Member of Society since 1948, and of Committee E-7 on Non-Destructive Testing since 1949. Affiliated also with the American Society of Naval Engineers and the X-Ray Society, Mr. Sanford had served as a Navy inspector of materials at Washington during World War II.

**J. R. Thompson** (retired), Manager, Metallurgical Dept., American Steel and Wire Co., Cleveland, Ohio (suddenly, April 25, 1953). Prior to his retirement in 1952 Mr. Thompson had represented his company in ASTM for a number of years, serving on Committees A-1 on Steel, and B-1 on Wires for Electrical

Conductors, and many subgroups of both committees. He also had represented the American Iron and Steel Institute on ASA Sectional Committee on Bare Electrical Conductors.

**Arthur J. Tuscany**, who conducted his own office for association management and related business consulting (Arthur J. Tuscany Organization), died June 5, 1953, at the age of 59, at his home, 3705 Rocky River Dr., Cleveland, Ohio. A native of Cleveland, Mr. Tuscany received his business training in Cleveland business colleges. After an early career at Johns-Manville Co. and Post Tractor Co., he entered his chosen Association Management field and served as manager of the following organizations at various times: Ohio Foundries Assn., Gray Iron Founders' Society, Metal Lath Manufacturers Assn. and Foundry Supply Assn. Mr. Tuscany had been affiliated with ASTM since 1932, and had represented various technical organizations through the years on a number of the technical committees of the Society. He was very active for many years in the work of the ASTM Cleveland District Council, serving as Secretary 1934-1940, and heading the Council as Chairman 1940-1950.

## DEATHS...

**LaVerne E. Cheyney** (aged 42 years), Manager, Contract Research Dept., Minnesota Mining & Manufacturing Co., Adhesives and Coatings Div., Detroit, Mich., died suddenly on May 21, 1953, while en route by train from St. Paul to Detroit. A native of Akron, Ohio, where he was educated in secondary schools and the University of Akron, Mr. Cheyney received an M.S. from the University of Pennsylvania and a Ph.D. from Ohio State University. He had been associated with Minnesota Mining & Manufacturing Co. since 1949 in various technical capacities. He was the author of 40 technical articles specializing in rubber and plastics, and had been granted sixteen U. S. patents and many foreign ones. A member of many scientific and technical groups, he had been especially active in the local sections of the American Chemical Society. In ASTM he had served for many years on Committee D-11 on Rubber and Rubber-Like Materials, and several of its subgroups, heading the subcommittee concerned with adhesion tests.

**W. G. Demarest**, Manager, Clay Products Association of the Southwest, Austin, Tex. (June, 1953). Representative of the Association and personal member of the Society since 1939. Mr. Demarest had participated in the activities of Committee C-15 on Manufactured Masonry Units, rendering valued service on Subcommittees VI on Glazed Brick and Tile, and VII on Structural Clay Tile. His loss will be felt especially in Subcommittee VII which he has headed as chairman since 1950.

**Lloyd B. Jones**, retired Engineer of Tests, Pennsylvania Railroad Co. (Al-

## NEW MEMBERS...

The following 103 members were elected from April 24 to June 23, 1953, making the total membership 7580 . . . Welcome to ASTM

Note—Names are arranged alphabetically—company members first then individuals

### CHICAGO DISTRICT

**Clinton Co., The**, Herbert J. Buck, Vice-President, 1210 Elston Ave., Chicago 41, Ill.

**Pace Associates**, William B. Cobb, Partner, 54 W. Jackson Blvd., Chicago 4, Ill.

**Byers, John A.**, Vice-President, James B. Clow and Sons, Chicago, Ill. For mail: Box 6600A, Chicago 80, Ill.

**Doke, E. G.**, Vice-President, MacLean-Fogg Lock Nut Co., 5535 N. Wolcott Ave., Chicago, Ill. For mail: 1025 Willow Rd., Winnetka, Ill.

**Grundy, A. V.**, Director, Container Labs., Quartermaster Corps., United States Department of the Army, Chicago, Ill. For mail: 9650 N. Keystone Ave., Skokie, Ill.

**Hauger, L. E.**, Reynolds Metals Co., First Ave and Forty-ninth St., Brookfield, Ill.

**Keene, K. L.**, Manager of Physical Testing Lab., U. S. Rubber Co., Mishawaka, Ind.

**Larson, Edward W., Jr.**, Instructor, Civil Engineering Dept., Northwestern University, Evanston, Ill.

**Mays, John Merritt**, Chief Engineer (Receiving Tube), Crosley Div., Avco Manufacturing Corp., Batavia Tube Plant, Batavia, Ill. For mail: 528 Fox St., Aurora, Ill.

**Milwaukee Public Library, Science and Industry Dept.**, Milwaukee 3, Wis.

**Parks, William W.**, Mechanical Research Engineer, Vapor Heating Corp., 4501 W. Sixteenth St., Chicago 23, Ill.

**Rickert, Adam J.**, District Manager, Pittsburgh Testing Lab., 131 E. Pittsburgh Ave., Milwaukee, Wis.

**Sandmeyer, William K.**, Assistant to General Manager, Cyclone Fence Dept., American Steel and Wire Div., United States Steel Corp., Box 260, Waukegan, Ill.

**Spangler, Merlin G.**, Research Professor, Civil Engineering, Iowa State College, Ames, Iowa.

**Stimple, V. C.**, Engineer, MacLean-Fogg Lock Nut Co., 5535 N. Wolcott Ave., Chicago 40, Ill.

### DETROIT DISTRICT

**Hobbs, Lindsey M.**, Associate Professor, University of Michigan, Department of Chemistry and Metallurgical Engineering, Ann Arbor, Mich. For mail: 3211 E. Engineering, Ann Arbor, Mich.

**Parkinson, Robert E.**, Supervisor, Materials Research, The Kawneer Co., Niles, Mich.

**Voydanoff, Eli**, Foundry Chemist, Pontiac Motor Div., General Motors Corp., Pontiac, Mich. For mail: 3616 Oakshire, Pontiac, Mich.

### NEW ENGLAND DISTRICT

**Surprenant Manufacturing Co.**, Albert H. Surprenant, President, 199 Washington St., Boston 8, Mass.

**Allen, Ralph W.**, Chief Chemist and Factory Manager, Heveatex Corp., 78 Goodyear Ave., Melrose 76, Mass.

**Button, Dale W.**, Technical Director, Globe Manufacturing Co., Fall River, Mass. For mail: 40 Prospect St., W. Barrington, R. I.

**Chiulli, Anthony F.**, Chief Chemist, Randolph Manufacturing Co., Inc., 32 S. Main St., Randolph, Mass.

(Continued on page 84)

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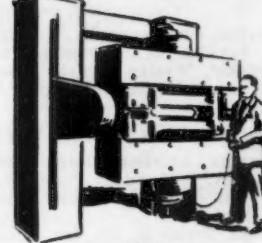
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260 KV



X-RAY UNIT



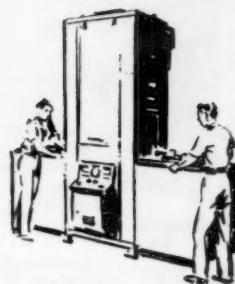
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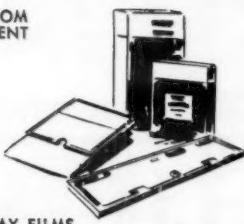


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(Continued from page 82)

Gross, Grosvenor M., Consulting Engineer, 141 Charles St., Boston, Mass.  
Stickel, Wesley Newell, Research Director, Texon, Inc., South Hadley Falls, Mass.

#### NEW YORK DISTRICT

Bendix Aviation Corp., Red Bank Div., J. A. Richardson, Senior Chemical Engineer, Electron Tube Plant, Eatontown, N. J.  
Ross, Frank B., Co., Inc., John J. Marvinny, Chief Chemist, 6-10 Ash St., Jersey City 4, N. J.  
Somers Brass Co., Inc., Stephen Banno, Annealing Supervisor, 94 Baldwin Ave., Waterbury 20, Conn.  
Utica Drop Forge and Tool Corp., F. N. Darmara, Vice-President, Clayville Plant, Utica 4, N. Y.  
Healey, Michael V., Metallurgical Engineer, General Electric Co., 1 River Rd., Schenectady 5, N. Y. For mail: 1547 Dean St., Schenectady, N. Y.  
Hotchkiss, Allan G., Industrial Heating Dept., General Electric Co., 1 River Rd., Schenectady 5, N. Y.  
Johnson, Stanley J., Chief Engineer, Greer & McClelland, 98 Greenwood Ave., Montclair, N. J.  
Macaulay, Donald, President, Paper Quality Control, Inc., 1130 Hardscrabble Rd., Chappaqua, N. Y.  
Marvin, Walter, President, Templar Oil Products Co., Inc., 125 Fifty-first St., Brooklyn 32, N. Y.  
Molnar, Nicholas M., President, Fine Organics, Inc., 211 E. Nineteenth St., New York 3, N. Y.  
Neill, John V., Jr., Junior Executive, Neill Supply Co., Inc., 47-75 Forty-eighth St., Woodside, Queens, N. Y. For mail: 1578 Middle Neck Rd., Port Washington, L. I., N. Y. [J]  
Pansini, Anthony J., Manager, Meters and Distribution Engineering, Long Island Lighting Co., 175 Old Country Rd., Hicksville, N. Y.  
Sparrow, Lawrence R., Materials Engineer, Kefay Manufacturing Corp., Kinefix Instrument Div., 902 Broadway, N. Y. [J]  
Stevens Institute of Technology, Department of Metallurgy, Alfred Bornemann, Professor of Metallurgy, Hoboken, N. J.  
Stoll, Reiner G., Assistant Manager, Celsane Corporation of America, Box 1000, Summit, N. J.  
Welch, William, Jr., Assistant Vice-President and Engineering Manager, Long Island Lighting Co., Box 178, Garden City, N. Y.

#### NORTHERN CALIFORNIA DISTRICT

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Ryan Aeronautical Co., C. L. Bates, Assistant Director of Engineering, 2701 Harbor Dr., San Diego 12, Calif.

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Hafer, Richard, Finishing Engineer, Reynolds Metals Co., 2500 S. Third St., Louisville, Ky.  
Morgan, John B., Civil Engineer, A. M. Kinney, Inc., 2905 Vernon Pl., Cincinnati, Ohio. For mail: 174 W. Main St., Chillicothe, Ohio. [J]  
Settle, J. E., President, Settle Engineers, Inc., Peoples Bldg., Charleston, W. Va. For mail: Box 1047 Charleston, W. Va.  
Snider, Robert F., Director, Research and Development, Franklin Glue Co., 119 W. Chestnut St., Columbus 15, Ohio.  
Thomas, Ray, Executive Vice-President and General Manager, Vimasco Corp., Box 6043, Station A, Charleston, W. Va. For mail: 207 Sneller Dr., Fort Hill, Charleston 4, W. Va.  
Wirth, Richard, Carton Specifications Supervisor, Ball Brothers Co., Inc., Muncie, Ind.  
Wolff, Ursala Elisabeth, Research Engineer, Link-Belt Co., 220 S. Belmont St., Indianapolis, Ind.

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Templar Oil Products Co., Inc., Louis Campagnoli, Chief Chemist, Box 286, South River, N. J.  
Althouse, Richard A., Assistant Division Purchasing Agent, E. I. du Pont de Nemours and Co., Inc., 1007 Market St., Wilmington, Del.  
Bogert, Allen Z., President, A. Z. Bogert Co., Morris Rd., Ambler, Pa.  
Frager, Max, Chief Engineer, Everite Machine Products Co., 3948 Filbert St., Philadelphia 4, Pa.  
Lamm, Raymond R., Chief Chemist, A. Z. Bogert Co., Morris Rd., Ambler, Pa.  
Saxer, Robert A., Chief Metallurgist, Wickwire Spencer Steel Div., Colorado Fuel and Iron Corp., Claymont Plant, Claymont, Del. For mail: 22 W. Dale Rd., Northfield, Wilmington 3, Del.  
Seller, W. W., Quality Control Manager, Caterpillar Tractor Co., Melody Lane, York, Pa.  
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Aaron, Joseph S., Lubrication Chemist, National Tube Div., United States Steel Corp., 525 William Penn Pl., Pittsburgh 30, Pa. For mail: National Tube Research Lab., 327 Craft Ave., Pittsburgh 13, Pa.  
Hoak, Richard D., Senior Fellow, Mellon Institute of Industrial Research, Pittsburgh 13, Pa.  
Hull, Lee, Metallurgist, Struthers Wells Corp., Titusville Forge Div., Titusville, Pa.  
Lewis, Clifford J., Senior Fellow, Mellon Institute of Industrial Research, 4400 Fifth Ave., Pittsburgh 13, Pa.  
Metzger, Melvin C., Metallurgist, Universal Cyclops Steel Co., Titusville, Pa.  
Read, George W., Jr., Manager, Sauereisen Cement Co., 1045 N. Canal St., Pittsburgh 15, Pa.  
Smith, Charles O., Research Engineer, Aluminum Research Labs., Aluminum Company of America, New Kensington, Pa. For mail: 523 Spring St., New Kensington, Pa.

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Steimke, Frank C., Director of Research, Walsh Refractories Corp., Box 88, Vandalia, Mo.

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Brantley, L. Reed, Chairman, Department of Chemistry, Occidental College, Los Angeles 41, Calif.  
Fletcher, David A., Junior Test Engineer, Consolidated Vultee Aircraft Corp., San Diego, Calif. For mail: 506 S. Comstock Ave., Whittier, Calif.  
Los Angeles County of Air Pollution Control District, Gordon P. Larson, Director, 5201 Santa Fe Ave., Los Angeles, 58, Calif.

#### WASHINGTON (D. C.) DISTRICT

Flanakin, H. A. Mike, Highway Engineer, American Trucking Assn., Inc., 1424 Sixteenth St., N. W., Washington 6, D. C.  
Hockman, Arthur, Materials Engineer, National Bureau of Standards, Div. 10.1, Washington 25, D. C.  
Jain, J. S., Technical Attaché, Embassy of India, 2107 Massachusetts Ave., N. W., Washington 8, D. C.  
Long, William T., Highway Engineer, Maryland State Roads Commission, 108 E. Lexington St., Baltimore, Md. For mail: 520 Albermarle St., Baltimore 2, Md.

#### WESTERN NEW YORK-ONTARIO DISTRICT

Cornell, William D., Project Engineer, American Machine and Foundry Co., Box 187, Station F, Buffalo 12, N. Y.  
King, H. I., Sales Engineer, The Cooksville Co., Ltd., 1055 Yonge St., Toronto, Ont., Canada.  
Raymo, Arthur J., Works Manager, Fitzgibbons Boiler Co., Inc., 23 Mercer St., Oswego, N. Y.  
Schoch, M. G., Jr., Superintendent, Quality Control, Hewitt-Rubber Div., Hewitt-Robins, Inc., 240 Kensington Ave., Buffalo 5, N. Y.  
Thompson, Frederick C., Stainless Steel Service Engineer, Allegheny Ludlum Steel Corp., 66 Howard Ave., Dunkirk, N. Y. For mail: West Lake Rd., Dunkirk, N. Y.

#### UNITED STATES AND POSSESSIONS

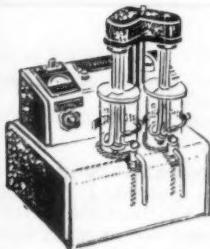
Annand, J. D., Partner, Annand, Boone & Lei, 1530 S. W. Taylor St., Portland 5, Ore.  
Chapman Chemical Co., Eldon A. Behr, Manager, Technical Dept., Box 3158, Mallory Station, Memphis 9, Tenn.  
Cobbe, Alfred G., Manager, Technical Service, Cabot Carbon Co., Box 1101, Pampa, Tex.  
Dow Chemical Co., Rocky Flats Plant, R. T. Paslay, Librarian, Box 2131, Denver, Colo.  
Erwin, Robert, Consulting Chemist, Erwin Chemical Lab., 3033 Grand Ave., Coconut Grove 33, Fla.  
Johnson, Melvern E., District Manager, Pittsburgh Testing Lab., 2323 Third Ave., Seattle 1, Wash.  
New, Harry E., Technical Sales Representative, Chemstrand Corp., Decatur, Ala.  
Vandervelde, Robert W., Branch Manager, Refinery Supply Co., Box 2050, Houston 1, Tex.

#### OTHER THAN U. S. POSSESSIONS

Arabian American Oil Co., W. R. Davis, Laboratory Supervisor, Oil Operations Lab., G. O. Producing Div., Dhahran, Saudi Arabia.  
Laboratoire de Recherches et de Contrôle du Caoutchouc, Directeur, 52, Rue Brancion, Paris XV<sup>e</sup>, France.  
Nacional de Cobre, S. A., J. A. Casas, Plant Superintendent, Poniente 134, No. 719, Col. Vallejo, Mexico, D.F. 16, Mexico.  
Floyd, Joseph, Chief Analytical Chemist, Clarke, Chapman and Co., Ltd., Victoria, Works Gateshead, Co., Durham, England.  
Guerra, Guido, Professor of Civil Engineering and Director, Library of the Faculty of Engineering, University of Naples 16, via Mezzo Cannone, Naples, Italy.  
Hawke, C. E., Chief Engineer, Charles Warnock and Co., Ltd., 632 Sherbrooke St., Montreal, P.Q., Canada.  
Jacoby, B., Sales Manager, Losenhausenwerk, Bürgmillerstr 35, Düsseldorf-Grafenberg, Germany.  
Marian, J. E., Head of Department, Swedish Forest Products Research Lab., Drottning Kristinas vag 67, Stockholm, Sweden.  
Miedel, Hermann, Chief Chemist, Veith-Gumini Werke A. G., Hoechst Odenwald, Germany.  
Nuttall, George E., Professional Engineer, International Harvester Co. of Canada, Ltd., Richmond St., Chatham, Ont., Canada.  
Powell, R. H., Technical Director, Griffin & Tatlock, Ltd., Kemble St., Kingsway, London, W.C. 2, England.  
Rehder, J. E., Director, Technology and Research, Canada Iron Foundries, Ltd., 921 Sun Life Bldg., Montreal, P. Q., Canada.  
Rourke, T. A., Plant Engineer, Dominion Lime, Ltd., Lime Ridge, P.Q., Canada.  
Santos, N. M., Chief Chemist, Cemento Aratu, S. A. Caixa Postal 1121, Bahia, Brazil.  
Wendtner, K., Assistant Librarian, Bowater's Development and Research, Ltd., Northfleet, Kent, England.

\* J denotes Junior Members.

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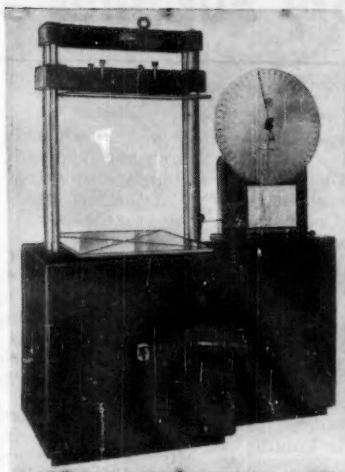
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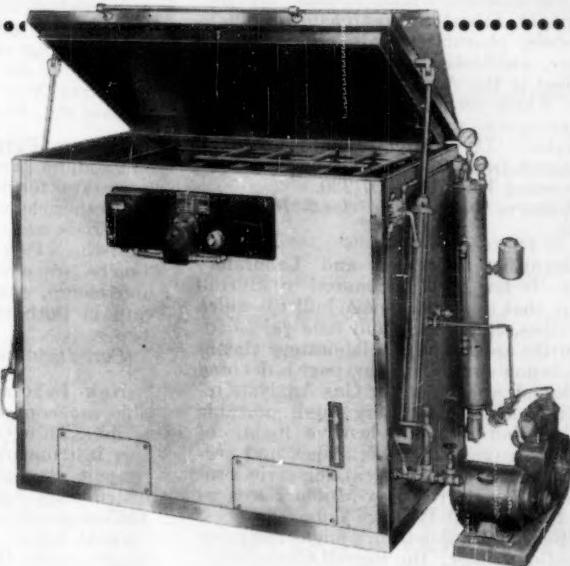
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## NEWS NOTES ON Laboratory Supplies and Testing Equipment

### Catalogs and Literature

**Densitometer Comparator**—Now available from Baird Associates is an eight-page bulletin entitled "Densitometer Comparator." Bulletin 39, free of charge, offers descriptions and illustrations of densitometers. This information deals with optical transmission or density of photographic material, an important accessory for spectrographic analysis.

Baird Associates, Inc., 1416 Massachusetts Ave., Cambridge 38, Mass.

**Testing Topics**—Recently announced by Baldwin-Lima-Hamilton Corp. is Volume 8, No. 2, of "Testing Topics." Four articles are featured as follows: wire tensometer for prestressed concrete research; how to design a casting; how to make a bonded electric resistance strain gage with mercury; and analogue-to-digital conversion. Copies of the issue are now available.

Baldwin-Lima-Hamilton Corp., Phila. 42, Pa.

**Automatic Moisture Tester**—An illustrated four-page folder has been released by Beckman Instruments containing the latest information on the new Beckman Aquameter, a high-speed electronic device which titrates for moisture automatically. This instrument utilizes the Karl Fischer "dead-stop" reaction for water measurements. The brochure explains push-button moisture testing of such materials as paper, foodstuffs, petroleum products, alcohols, pharmaceuticals, ethers, animal tissue, antibiotics, and blood. Also described is the Aquameter's simple operation, which permits untrained technicians to run precise water analyses in one or two minutes. Descriptive literature can be obtained from Beckman Instruments by requesting Data File 307-220.

Beckman Instruments, South Pasadena, Calif.

**Scientific Apparatus and Laboratory Aids**—It has been announced by Burrell Corp. that a new four-page bulletin which describes, illustrates, and lists prices for scientific apparatus and laboratory chemicals, is now available. One page is devoted to Burrell apparatus for Gas Analysts including both laboratory and portable models and a comprehensive listing of modern reagents. Other pages and sections of the compact, catalog-style brochure, offer Burrell Box-Muffle Furnaces and Burrell Unit-Package Tube Furnaces; the Burrell Combustron, a high-frequency induction heater; the Burrell Carbotrane, a unit-package carbon train; and the Burrell Shaker, a flexible automatic shaker which is designed to simulate human wrist action. Other literature describing the items shown in more detail is listed. Copies may be had free on request.

Bulletin No. 328, Burrell Corp., 2223 Fifth Ave., Pittsburgh 19, Pa.

**Clamps**—Recently announced by Fisher Scientific Co. is Catalog FS-228 listing a large variety of special-purpose clamps

designed by chemists in industrial laboratories and made of Castaloy, an alloy with a tensile strength of 47,000 psi.

Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

**Optical Benches and Accessories**—A new publication, Bulletin 156-53, has been released by The Gaertner Scientific Corp. listing and describing Optical Benches and accessories.

The Gaertner Scientific Corp., 1201 Wrightwood Ave., Chicago 14, Ill.

**Microphotometers**—Complete information about the Knorr-Albers Recording Microphotometer and the Vincent-Sawyer Spotting Microphotometer is now available in a completely revised 12-page catalog, "Knorr-Albers and Vincent-Sawyer Microphotometers," just published by the Leeds & Northrup Co.

Leeds & Northrup Co., 4934 Stenton Ave., Phila. 44, Pa.

**Universal Testing Machines**—Bulletin 47 gives detailed information on the two complete lines of Olsen Super "L" testing machines, standard and de luxe models. A description is given of the principle and operation of the exclusive Olsen SelecTrance Electronic Indicating System, which provides a 50 to 1 spread of testing ranges and permits changing of ranges during test with the flip of a switch. In addition, the 24-page bulletin fully describes the features of the Standard Super "L" for testing standard size specimens and the de luxe models with greater clearances for testing a wider range of specimen sizes. Copies of Bulletin 47 are available upon request.

Tinus Olsen Testing Machine Co., 1120 Easton Rd., Willow Grove, Pa.

**Sodium Peroxide Bombs**—Five different sodium peroxide bombs and accessory apparatus for determining sulfur, halogens, and other elements in combustible organic materials are described in a new 8-page bulletin. Parr Instrument Co. peroxide bombs are offered in four different sizes for macro, semimicro, and micro tests, and in both electric and flame ignition types.

Parr Instrument Co., Moline, Ill.

**New Laboratory Catalog**—Now available are copies of Catalog No. 100, describing an entire line of scientific laboratory instruments, apparatus, supplies, and reagent chemicals. Although a general distribution has been made of this new 1465-page publication, published by E. H. Sargent & Co., persons who desire a copy, should make their requests on company letterheads.

E. H. Sargent & Co., 4647 W. Foster Ave., Chicago 30, Ill.

**Laboratory Equipment**—"What's New for the Laboratory," announced by the Scientific Glass Apparatus Co., Inc. includes: a new line of low-priced industrial balances, a number of polyethylene aids (miniature funnel, stirring rod, scraper spatula, pipet jars, carboys, etc.), a utility water bath, duplex heater, penetrometer,

wet test meter, laboratory glassware washer, plus many others.

Scientific Glass Apparatus Co., Inc., Bloomfield, N. J.

**Laboratory Apparatus**—A new 72-page catalog recently published by Soiltest, Inc. describes and illustrates over 800 items of apparatus for engineering tests of soils, concrete, and bituminous materials. The extensive soil testing equipment section of the catalog presents information on triaxial, consolidation, California bearing ratio, compaction, pore pressure, and all of the standard apparatus for field and laboratory engineering tests of soils.

Catalog No. 53, Soiltest, Inc., 4520 W. North Ave., Chicago 39, Ill.

### Instrument Notes

**New Extension Indicator**—A new Extension Indicator for measuring extension under load in tension test specimens, and automatically controlling auxiliary devices, is announced by Baldwin-Lima-Hamilton Corp. The Extension Indicator delivers signals at preset values of extension. Signals are visual, audible, and electrical, closing relay contacts and actuating an auxiliary device such as a load holder, load indicator, load printer, or other device. Automatic printing of load values is under development. The instrument is essentially a balancing microformer actuated through an electronic amplifier under the control of the extensometer microformer. Only control on the instrument is a dial graduated in tenths of a per cent extension up to 0.7 per cent by means of which the signals can be set for the desired extension.

Baldwin-Lima-Hamilton Corp., Phila. 42, Pa.

**Extensometer and Recorder**—The first SR-4 type electrical extensometer to be constructed commercially is announced by Baldwin-Lima-Hamilton Corp. The new extensometer is for use in tensile strength tests of standard 0.505-in. diameter test specimens with 2-in. gage length. Stress ranges depend upon testing machine indicator ranges. An outstanding feature is said to be the convenience and speed with which it can be mounted on and removed from the specimen to which it is spring-clamped. Load is recorded by movement of the stylus parallel to the axis of the recorder drum. Two recorder load ranges are available for each indicator range, one providing full recorder scale for 50 per cent and the other for 100 per cent of each indicator range.

Baldwin-Lima-Hamilton Corp., Phila. 42, Pa.

**Instrument Analyzes Hydrocarbon Gases**—A new instrument for the rapid, semi-automatic analysis of hydrocarbon gases has recently been introduced by Burrell Corp. The instrument performs rapid, accurate analyses of hydrocarbon mixtures in from 1 to 3 hr.

Burrell Corp., 2223 Fifth Ave., Pittsburgh 19, Pa.

(Continued on page 88)



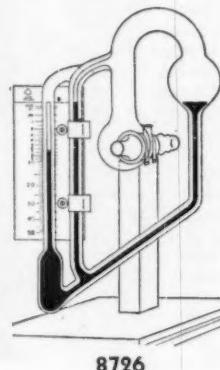
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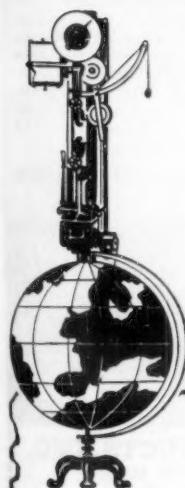
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"Firstly thank you for the prompt manner in which you dealt with our cabled request of September 15th.

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Request Catalog 53

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Southern Sales Rep.: JOHN KLINCK  
304 West Forest Ave., North Augusta, S. C.

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## POSEY IRON WORKS, Inc.

Brick Machinery Division

LANCASTER, PENNSYLVANIA

(Continued from page 86)

New Small Capacity Tensile Tester—A newly developed Small Capacity Tensile Tester, manufactured by John Chatillon & Sons, is designed to measure the tensile properties of fiber, cloth, cord, rubber, and many other similar materials. It is operated by means of a handwheel which is graduated to read extension in increments of 0.001 in. This handwheel drives a single thread worm gear which automatically holds the tension at any given point. Tension load is ready by a single pointer which will remain at the point of maximum load until it is manually reset to zero.

John Chatillon & Sons, 85 Cliff St., New York 38, N. Y.

Custom Leak Detection Service—A custom leak detection service is now available from the Analytical Service Dept. of Consolidated Engineering Corp. The service is designed for tests of either vacuum or pressure prototypes, development models, pilot models, special laboratory equipment, etc. Inert, non-contaminating helium is used as a probe gas, and its passage through even the smallest leak in parts or equipment under test is instantly detected by the Consolidated 24-101A Leak Detector, a simplified, portable mass spectrometer sensitive to minute traces of helium. No liquids or corrosive, toxic, or explosive materials are used.

Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 15, Calif.

New Saybolt Viscosimeter—It has been announced that Fisher Scientific Co. has redesigned the Saybolt Viscosimeter. This instrument can be used for both Furul and Saybolt Universal viscosity measurements. The bath is spot welded, soldered for leak-proof construction. A drain overflow holds the level of bath liquid to the prescribed height on the Saybolt tubes. The bath is brought to temperature quickly with a variable-input heater delivering 0-1000 w. A 50-w intermittent heater, controlled by a special bimetallic thermoregulator, holds the bath at the desired temperature.

Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

New Series of Warburg Apparatus—E. Machlett & Son announces the addition of a new series of Warburg Apparatus, known as the Bronwill series, to their varied line of manometric research instruments. According to Machlett, the Model USL attains, automatically, temperature constancy of  $\pm 0.005^{\circ}\text{C}$  corresponding to a pressure variation in the reaction vessels of only 0.01 mm column of water. Shaking amplitude is adjustable anywhere from 0 to 8 cm and shaking frequency, indicated by a tachometer, can be steplessly regulated from 0 to 220 strokes per minute.

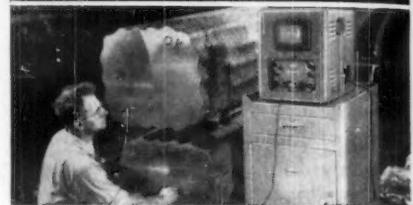
E. Machlett & Son, 220 E. 23rd St., New York 10, N. Y.

100-Kv Electron Microscope—Screen magnification of North American Philips Co.'s powerful new instrument is continuously variable from 1000 $\times$  to 60,000 $\times$  and the microscope is capable of producing micrograms of 50 Å resolution or better. Accelerating potentials of 40, 60, 80 and 100 kv are provided, with finger tip control. The new high-power microscope has an extremely large field and permits recording in a single photograph, areas which might otherwise require a mosaic of six individual sections.

North American Philips Co., Inc., Mount Vernon, N. Y.

(Continued on page 90)

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100 CHESTNUT STREET, NEWARK 5, N.J. — Dept. AS-753

(Continued from page 88)

**New Versatile Digital Recorder**—A new Digital Recorder, Model 960 for high-speed, permanent recording, has been announced by the Potter Instrument Co., Inc. This instrument has been designed for use with any of the line of Potter Counter-Chronographs, Frequency-Time Counters, Scalers, or any similar equipment which provides a binary coded decimal indication. Data are recorded on electro-sensitive paper.

Potter Instrument Co., 115 Cutter Mill Rd., Great Neck, N.Y.

**New Water Bath**—A new economical-type Water Bath (S-84870), which establishes a constant-temperature reservoir for laboratory work, is now available from E. H. Sargent & Co. The circulating and heat control systems are enclosed in a cast metal housing which is supported on the rim of a 12 by 12-in. Pyrex brand glass reservoir. Operating temperatures may be set over the range of room temperature to 60°C.

E. H. Sargent & Co., 4647 W. Foster Ave., Chicago 30, Ill.

**The Sargent Ampot**—An electrometric titration instrument, named the Ampot, has recently been designed and manufactured by E. H. Sargent & Co. The polarizing circuit consists of a 3-v dry cell powered voltage divider network. The dial reads directly in millivolts per volt span applied to the cell terminals. It is portable and vibration insensitive and suited to amperometric titration with the dropping mercury electrode as well as to other common types of metal electrode titrations.

E. H. Sargent & Co., 4647 W. Foster Ave., Chicago 30, Ill.

**New Particle Size Distribution Analyzer**—A newly designed instrument which quickly and accurately determines the particle size distribution of powdered materials has just been announced by the Sharples Corp. Research Labs. This precision instrument, the Sharples Micromerograph, utilizes a technique in which powder particles are dispersed in air and are allowed to settle under the action of gravity through a tube upon a servoelectronic balance. The balance yields a continuous record of the weight of powder settled, plotted against time. Through the application of Stokes' Law of Fall, a particle size distribution curve is obtained. The Sharples Micromerograph provides continuous data and reduces the time required for a test run to as little as 15 min.

Sharples Corp. Research Labs., 424 W. Fourth St., Bridgeport, Pa.

**High-Sensitivity Electrophoresis-Diffusion Instrument**—A new Model H Electrophoresis-Diffusion Instrument said to achieve double sensitivity by directing light through the cell and specimen twice has been announced by Specialized Instruments Corp. Other features include compactness and accessibility of operating controls and optical elements from the observation and recording position. Housed in a single laboratory cabinet, the apparatus includes a servo-controlled cell turret capable of carrying three individual cell assemblies, each of which is continuously connectable to an individually regulated and calibrated power supply. Any cell assembly can be rotated into position for observation or automatic photography.

Specialized Instruments Corp., 662 O'Neill Ave., Belmont, Calif.

(Continued on page 92)

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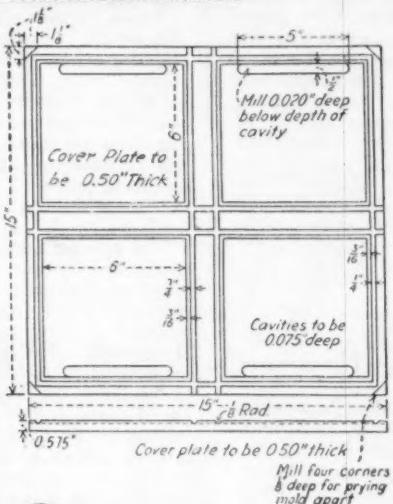
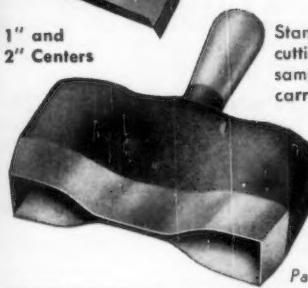
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A new Fade-Ometer  
replaces a veteran on  
the job for 25 years

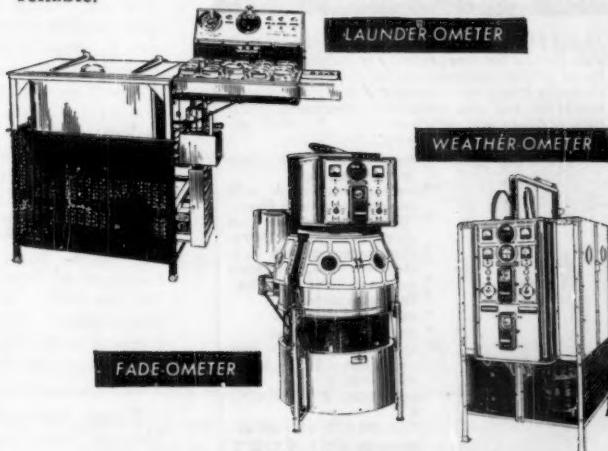
In January of 1924, General Aniline & Film Corporation purchased its first Atlas Fade-Ometer for use in the company's research laboratory as the means for testing the light-fastness of General Aniline dyestuffs under accelerated conditions. In 1949 this same machine—after 25 years of dependable use—was turned in to us on the purchase of a new machine which immediately took its place alongside the many other Fade-Ometers bought by General Aniline (The Model FDA pictured above was purchased in 1940) during the intervening years.

By subjecting product samples to Fade-Ometer testing, General Aniline technicians can accurately foretell how dyed materials will wear and look in any climate and however used. Thus, the General Aniline reputation for quality is carefully protected at all times.

\* \* \*

The source of light in the Fade-Ometer in the photo is still as reliable as it was on the day the machine was delivered, and is still the most accurate reproduction of Noon June sunlight ever devised.

Throughout the years, however, Atlas has maintained its own research program dedicated to improving the entire line of Atlas-Ometers—the Fade-Ometer, Weather-Ometer, and Launder-Ometer. The result has been machines that are simpler to operate, faster in providing results, more economical, and as always—thoroughly reliable.



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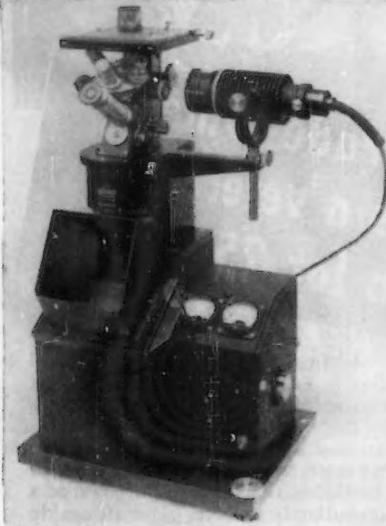
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  - many other important features and accessories including calibrated mechanical stage, filters, polarizing apparatus, micrometer eyepiece, film holder, hardwood case, etc.
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Write to Dept. M-7 for illustrated literature

**United Scientific Co.**

204-206 MILK STREET, BOSTON 9, MASS.

(Continued from page 90)

**High-Resolution Nuclear Magnetic Resonance of Spectrometer**—Molecular structures are said to be determined and components in a mixture identified by the new Varian Model V-4300 High Resolution Nuclear Magnetic Resonance Spectrometer. Principally applicable to compounds containing hydrogen or fluorine, it is claimed that the new instrument can detect differences in the nmr (nuclear magnetic resonance) structural spectra of isomers (illustrated—traces from two  $c_5F_{10}O$  isomers). Comparison of resulting oscilloscope traces against those obtained from known fluorine compounds makes it possible to identify structure in the two isomers.

*Varian Associates, Dept NEAD, San Carlos, Calif.*

### Instrument Company News

**Bausch & Lomb Optical Co., Rochester, 2, N. Y.**—Election of Lyle B. McKinley as vice-president in charge of Scientific Instrument Sales, and Carl A. Day as vice-president in charge of Manufacturing was announced recently by Bausch & Lomb Optical Co. Mr. McKinley graduated from Kansas State Teachers College in 1925 and since 1947 has been sales manager of the Scientific Instrument Div. Mr. Day joined Bausch & Lomb in 1931 after graduating from the U. S. Naval Academy and has been works manager of all Rochester manufacturing, production control, and plant maintenance activities.

**Central Scientific Co., Chicago, Ill.**—Russell L. Lawson, formerly vice-president of the Utica Knitting Co., Utica, N. Y., has been named executive vice-president of Central Scientific Co., according to John T. Gossett, president. The company, which manufactures and distributes scientific instruments and laboratory apparatus, is a wholly owned subsidiary of Cenco Corp. Mr. Lawson began his business career in 1931 after graduating from Cornell University where he majored in industrial engineering.

**Consolidated Engineering Corp., Pasadena, Calif.**—Promotion of three key executives of Consolidated Engineering Corp. by the company's board of directors, was announced by President Philip S. Fogg. Hugh F. Colvin has been named vice-president and general manager. Robert L. Smallman has been elected vice-president in charge of sales, and Victor Pollock appointed as treasurer. A graduate of the California Institute of Technology and the Harvard School of Business Administration, Mr. Colvin joined the electronic instrument firm in 1947 as treasurer and assistant to the president. Mr. Smallman, a graduate of the California Institute of Technology, formerly Director of Sales for Consolidated's Electromechanical Instrument Div., joined the firm in 1947. Mr. Pollock, a graduate of the Babson Institute in Mass., joined Consolidated Engineering in May, 1952, as assistant to the treasurer.

**Fisher Scientific Co., Pittsburgh, Pa.**—Manuel Nuno has been appointed the first technical representative of Fisher Scientific in the Republic of Mexico. He will head the Company's Mexico City office to assist chemists, metallurgists, and pathologists in the Republic's growing industrial, research, clinical, and university laboratories.

**Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.**—A new mid-Atlantic regional office, a two-story office building consolidating sales, service, and engineering, has been opened by the Minneapolis-Honeywell Regulator Co. on W. Hunting Park Ave., Philadelphia.

A new factory will be opened shortly at Warren Ill., to expand the production of the Micro Div. of Minneapolis-Honeywell Regulator Co., it was announced recently by W. W. Gilmore, president of the division. The new plant, a 10,000-sq ft building obtained under a lease arrangement, will become the division's fourth manufacturing operation, the other three being in Freeport, Ill., where the division is headquartered.

The appointment of Dr. Finn J. Larsen as director of research for Minneapolis-Honeywell Regulator Co. was announced recently. Since 1952, Dr. Larsen has been director of ordnance engineering for Honeywell. He will continue to have responsibility for this work, in addition to his new duties as research director. Dr. Larsen joined Honeywell after receiving his Ph.D. in 1948 from Iowa State College, where he also was an instructor in physics. He started as a physicist in the company's research department and before becoming director of ordnance engineering, he was assistant to the director of research.

**E. H. Sargent & Co., Chicago, Ill.**—Thomas H. Mints, Jr., formerly assistant secretary of E. H. Sargent & Co., has been elected a vice-president of the company. Mr. Mints has been continuously associated with the firm since his graduation from Yale.

### Laboratory News

**Bjorksten Research Labs., Inc., Chicago, Ill.**—Ground has been broken for a new laboratory building, which will contain 15,000 sq ft of laboratory space in addition to the four smaller buildings already in use. Work in the new laboratory building will consist largely of research in the plastics and polymer field. Facilities for organic synthesis, and supplementary radiotracer facilities, will also be provided.

**Greiner Glassblowing Laboratory, Los Angeles, Calif.**—This laboratory is now located at 3604 E. Medford St., Los Angeles 63, Calif.

**Lehigh University, Bethlehem, Pa.**—Lehigh University's new testing center will house the world's largest vertical universal testing machine—a 5,000,000-lb capacity hydraulic tension-compression machine. Auxiliary machines, in small laboratories to be provided, will permit extensive studies on the effect of repeated and dynamic loads which often cause failure through the fatigue of the material. Tests are expected to include all kinds of materials including concrete cylinders and blocks, aluminum and magnesium castings, fabricated steel, oil well shafts, wood, and wire rope.

**Don L. Quinn Co., Chicago III.**—Announcement has been made that the Don L. Quinn Co. has been purchased by Wilmer J. Balster and Peter J. Ziegler. Mr. Balster has been associated with the laboratory from 1927 through 1952. Peter J. Ziegler from 1940 to the present time. A modernization program is being initiated to improve facilities and service. The laboratory will continue to operate as an independent commercial testing laboratory under the name of the Don L. Quinn Co.

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